

# Five-Year Review Report

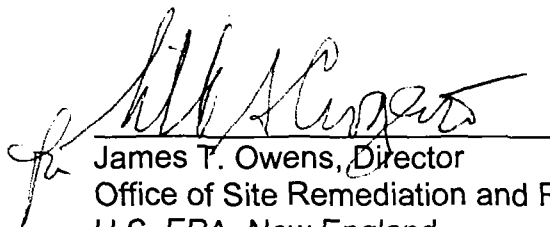
Third Five-Year Review  
for  
South Municipal Water Supply Well Superfund Site  
Peterborough, New Hampshire

August 2008

Prepared by:

The United States Environmental Protection Agency  
Region 1, New England  
Boston, Massachusetts



  
James T. Owens, Director  
Office of Site Remediation and Restoration  
U.S. EPA, New England

  
Date

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## ACRONYMS

AGQS	Ambient Groundwater Quality Standard
ARAR	Applicable or Relevant and Appropriate Requirement
B&M	Boston and Main
BART™	Biological Activity Reaction Test
bgs	below ground surface
COC	Contaminant of Concern
Code	Peterborough Code
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
1,1-DCA	1,1-Dichloroethane
1,1,1-DCE	1,1,1-Dichloroethylene
DNAPL	Dense non-aqueous phase liquid
EPA	Environmental Protection Agency
ESD	Explanation of Significant Differences
gpm	gallons per minute
Hull	Hull & Associates, Inc.
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
NHBB	New Hampshire Ball Bearings
NHDES	New Hampshire Department of Environmental Services
Nobis	Nobis Engineering, Inc.
NPL	National Priorities List
O&M	Operations and Maintenance
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
PAH	Polyaromatic Hydrocarbon
PCB	Polychlorinated biphenyl
PCE	Tetrachloroethene
PEL	Permissible Exposure Limit
ppb	parts per billion
RA	Remedial Action
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision

SDE Site	SDE, Inc. – Staff Development for Educators South Municipal Water Supply Well Superfund Site
1,1,1-TCA	1,1,1-Trichloroethane
TCE	Trichloroethene
TI	Technical Impracticability
µg/L	micrograms per liter
VOC	Volatile organic compound

## EXECUTIVE SUMMARY

This is the third five-year review for the South Municipal Water Supply Well (South Well) Superfund Site (Site). The review was conducted from March through June, 2008 in accordance with EPA Office of Solid Waste and Emergency Response (OSWER) Guidance No. 9355.7-03B-P. This report documents the results of this review and presents the results in accordance with the EPA OSWER Guidance, as well as previous review reports. This statutory five-year review is required since hazardous contamination remains at the Site above levels that allow for unlimited use and unrestricted exposure. The triggering action for this statutory five-year review is based on the signature date of the second five-year review, June 2, 2003.

The Record of Decision (ROD) for the Site was signed on September 27, 1989. An Explanation of Significant Differences (ESD) was issued on May 6, 1993 documenting modifications to the remedy principally for air emission controls and sediment excavation. A second ESD was issued on February 3, 1997 waiving certain Federal Drinking Water Standards for groundwater due to a technical impracticability, from an engineering perspective, to restore that portion of the contaminated groundwater beneath the New Hampshire Ball Bearings (NHBB) property (attachment to 1997 ESD, Section 2). This portion of contaminated groundwater is known as the "technical impracticability (TI) waiver area". The future concurrent use of the aquifer while effecting plume capture within the "TI waiver area" was the desired outcome of the remedy change. A result of a long term pump test using the South Well to evaluate this potential is described below.

The ROD called for a restriction on the use of the groundwater, in-situ vacuum extraction of contaminated soils, excavation and/or dredging with dewatering of sediments, wetlands restoration, groundwater extraction and treatment with air stripping and carbon columns for air emission control, and long-term environmental monitoring. Based on the determination of technical impracticability, three elements of the remedy were modified by the ESD: in-situ vacuum extraction of contaminated soils, air sparging, and groundwater extraction. The ROD set cleanup standards for trichloroethylene (TCE), tetrachloroethylene (PCE), 1,1,1-trichloroethane (1,1,1-TCA), 1,1-dichloroethylene (1,1-DCE), 1,1-dichloroethane (1,1-DCA), toluene, and vinyl chloride.

A Unilateral Administrative Order for the design, construction, operation and maintenance of the remedy became effective on July 9, 1990. NHBB, the party potentially responsible for the contamination, completed the design of the remedy which was approved by EPA on May 3, 1993. Construction began on June 7, 1993. The groundwater extraction and treatment system began operation in March of 1994 and has operated since then. The in-situ vacuum extraction system began operation in October of 1994 but ceased operation in 1997 when the second ESD was issued. Monitoring of groundwater quality and water levels has continued throughout the remedial design, construction and post-construction phases.

The groundwater extraction and treatment system has been in operation for the past fourteen years beginning in March of 1994. This five-year review includes Years 10 through 14 (2003 through 2007) of operation. The system has been consistently operating with interruptions only for routine maintenance and modifications to the process. There are currently five groundwater extraction wells operating as part of the extraction system: EX-1, EXH-3, EX-4, EX-5A, and EX-10.

From October 6, 2003 through February 3, 2005, a long term, three stage pumping test was performed on the South Well in conjunction with the operation of the extraction well containment/remedial system to determine if reactivation of the South Well was feasible. The pumping test demonstrated that the capacity of the containment system to capture all portions of the contaminant plume is exceeded when operating the South Well 24 hours per day at approximately 150 gallons per minute (gpm). The containment system (EX-4 and EX-10) with the South Well was pumping at a combined rate of approximately 244 gpm. Following the pumping test, a source area delineation investigation was performed to gain a better understanding of the extent and distribution of VOCs near two source areas, former Outfalls 002 and 003A.

The review of Site-related documents, data, operations and maintenance (O&M) procedures, applicable or relevant and appropriate requirements (ARARs), and Site inspection notes indicate that the remedy is not functioning as intended by the ROD. The ROD intended that the South Well would be reactivated. In order to restore the use of the aquifer for water supply purposes, evaluation of additional remedial technologies focused on dense non-aqueous phase liquid (DNAPL) source reduction, or combination thereof with containment, should be performed and implemented to target source areas.

Routine maintenance of the extraction system includes removal of the extraction well pumps for cleaning purposes. Aerobic and anaerobic bio-fouling iron and manganese consistently occurs in the pumps and lines associated with extraction wells EX-4 and EX-10. Cleaning of the pumps has been modified by altering the cleaning chemicals used and the residence time during which the pumps are submerged. Biofouling continues to occur approximately every three months following pump cleaning, thereby reducing flow rates.

One institutional control set in place by the ROD is not current and functioning as intended. The aquifer protection zoning overlay district established to prohibit the use of groundwater at the Site has not been maintained as of March 2005.

The vapor intrusion pathway was not evaluated in the original environmental assessment. There is insufficient data to evaluate the protectiveness of the remedy based on the vapor intrusion pathway. However, the presence of sub-slab soil gas and shallow groundwater VOC concentrations below the on-site building exceeding EPA's *OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* target groundwater concentrations for protection of indoor air indicates potential vapor intrusion concerns.

Five-Year Review Protectiveness Statement:

The remedy is not protective because of the following issues:

- The containment system cannot capture all portions of the containment plume while operating the South Well and contamination outside of the "TI waiver area" at the northern border of the NHBB facility is above drinking water standards;
- There is insufficient data to evaluate the protectiveness of the remedy based on the vapor intrusion pathway; and
- The aquifer protection zoning overlay is not currently maintained in the Peterborough Code revised March 2005.



The following actions need to be taken:

- Alternative remedial technologies focused on DNAPL source reduction need to be evaluated and implemented to increase the certainty and cost effectiveness of the remedy, and allow the concurrent use of the aquifer for water supply purposes;
- A vapor intrusion assessment should be implemented to determine if there is a viable inhalation exposure pathway to workers in the NHBB facility as well as any off-site businesses and/or residences that may be affected by the groundwater plume; and
- The aquifer protection zoning overlay district (Aquifer Protection District D) also needs to be reinstated by the town of Peterborough to the Peterborough Code, Chapter 245 Zoning.

## Five-Year Review Summary Form

SITE IDENTIFICATION		
<b>Site name (from WasteLAN):</b> South Municipal Water Supply Well		
<b>EPA ID (from WasteLAN):</b> NHD980671069		
<b>Region:</b> 1	<b>State:</b> NH	<b>City/County:</b> Peterborough/Hillsborough
SITE STATUS		
<b>NPL status:</b> <input checked="" type="checkbox"/> Final <input type="checkbox"/> Deleted <input type="checkbox"/> Other (specify) _____		
<b>Remediation status</b> (choose all that apply): <div style="display: flex; justify-content: space-around; margin-top: 5px;"> <span><input type="checkbox"/> Under Construction</span> <span><input type="checkbox"/> Operating</span> <span><input checked="" type="checkbox"/> Complete</span> </div>		
<b>Multiple OUs?*</b> <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		<b>Construction completion date:</b> 12 / 5 / 1994
<b>Has site been put into reuse?</b> <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO, continues as an industrial facility		
REVIEW STATUS		
<b>Lead agency:</b> <input checked="" type="checkbox"/> EPA <input type="checkbox"/> State <input type="checkbox"/> Tribe <input type="checkbox"/> Other Federal Agency _____		
<b>Author name:</b> Richard Goehlert		
<b>Author title:</b> Task Order Project Officer		<b>Author affiliation:</b> U.S. EPA Region I
<b>Review period:**</b> 3/24/08 to 6/30/08		
<b>Date(s) of site inspection:</b> 5 / 1 / 2008		
<b>Type of review:</b> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <div> <input checked="" type="checkbox"/> Post-SARA  <input type="checkbox"/> Non-NPL Remedial Action Site  <input type="checkbox"/> Regional Discretion </div> <div> <input type="checkbox"/> Pre-SARA  <input type="checkbox"/> NPL State/Tribe-lead </div> <div> <input type="checkbox"/> NPL-Removal only </div> </div>		
<b>Review number:</b> <input type="checkbox"/> 1 (first) <input type="checkbox"/> 2 (second) <input checked="" type="checkbox"/> 3 (third) <input type="checkbox"/> Other (specify) _____		
<b>Triggering action:</b> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <div> <input type="checkbox"/> Actual RA Onsite Construction at OU # _____  <input type="checkbox"/> Construction Completion  <input type="checkbox"/> Other (specify) _____ </div> <div> <input type="checkbox"/> Actual RA Start at OU# _____  <input checked="" type="checkbox"/> Previous Five-Year Review Report </div> </div>		
<b>Triggering action date (from WasteLAN):</b> 6/2/2003		
<b>Due date (five years after triggering action date):</b> 6/2/2008		

\* ["OU" refers to operable unit.]

\*\* [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

## **Five-Year Review Summary Form, cont'd.**

### **Issues:**

- Pumping of the South Well revealed that the containment system does not capture all portions of the contaminant plume while operating the South Well 24 hours per day at approximately 150 gpm. Currently, there are no engineering remedies in place that remove contamination source mass within the "TI waiver area" and thereby increase the certainty and cost effectiveness of containment. Contamination has been detected at concentrations above drinking water standards outside of the "TI waiver area" at the northern border of the NHBB facility. It is not known if the containment system captures this area of contamination.
- Soil vapor concentrations have been detected below the NHBB facility that exceed screening levels. In addition, drinking water standards used as clean-up levels remaining in effect for outside the "TI waiver area" are not designed to be protective of the vapor intrusion pathway.
- The aquifer protection zoning overlay district (Aquifer Protection District D) established by the town of Peterborough for the Site in the Peterborough Code, Chapter 245 Zoning to disallow groundwater use throughout the Site was not maintained when the Code was revised as of March 2005.

### **Recommendations and Follow-up Actions:**

- Alternative remedial technologies focused on DNAPL source reduction should be evaluated and implemented to increase the certainty and cost effectiveness of the remedy, and allow the concurrent use of the aquifer for water supply purposes. A Focused Feasibility Study is planned for the Site.
- A vapor intrusion assessment should be implemented to determine if there is a viable inhalation exposure pathway to workers in the NHBB facility as well as any off-site businesses and/or residences that may be affected by the groundwater plume.
- The aquifer protection zoning overlay district (Aquifer Protection District D) should be reinstated by the town of Peterborough to the Peterborough Code, Chapter 245 Zoning in 2009.

## Five-Year Review Summary Form, cont'd.

### **Protectiveness Statement(s):**

The remedy is not protective because of the following issues:

- The containment system cannot capture all portions of the containment plume while operating the South Well; and contamination outside of the "TI waiver area" at the northern border of the NHBB facility is above drinking water standards;
- There is insufficient data to evaluate the protectiveness of the remedy based on the vapor intrusion pathway; and
- The aquifer protection zoning overlay is not currently maintained in the Peterborough Code revised March 2005.

The following actions need to be taken:

- Alternative remedial technologies focused on DNAPL source reduction need to be evaluated and implemented to increase the certainty and cost effectiveness of the remedy, and allow the concurrent use of the aquifer for water supply purposes;
- A vapor intrusion assessment should be implemented to determine if there is a viable inhalation exposure pathway to workers in the NHBB facility as well as any off-site businesses and/or residences that may be affected by the groundwater plume; and
- The aquifer protection zoning overlay district (Aquifer Protection District D) also needs to be reinstated by the town of Peterborough to the Peterborough Code, Chapter 245 Zoning.

## **1.0 INTRODUCTION**

The purpose of this five-year review is to determine whether the remedy selected for the South Municipal Water Supply Well Superfund Site (Site) remains protective of human health and the environment. This report summarizes the five-year review processes, investigations, and remedial actions undertaken at the Site; evaluates the monitoring data collected over the past 14 years, with emphasis on the last five years; reviews Applicable or Relevant and Appropriate Requirement (ARARs) specified in the Record of Decision (ROD) for changes; and describes the current Site status.

The United States Environmental Protection Agency, Region 1 (EPA) prepared this five-year review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121 and the National Contingency Plan. CERCLA §121 states:

“If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the Site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such Site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.”

The EPA interpreted this requirement further in the National Contingency Plan; 40 Code of Federal Regulations (CFR) §300.430(f)(4)(ii) states:

“If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the Site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.”

This is the third five-year review for the Site. This statutory five-year review is required due to the fact that wastes are still contained on a portion of the Site and the groundwater is still being treated. Further, hazardous contamination will remain above the levels at the Site upon completion that allow for unlimited use and unrestricted exposure. The review was conducted from March through June, 2008 in accordance with EPA Office of Solid Waste and Emergency Response (OSWER) Comprehensive Five-Year Review Guidance (EPA, 2001). This report documents the results of this review and presents the results in accordance with the EPA

OSWER Guidance, as well as previous five-year review reports. The first five-year review was completed in June 1998. The second five-year review was completed in June 2003. The triggering action for this statutory five-year review is based on the signature date of the second five-year review, June 2, 2003.

EPA conducted this five-year review of the remedial action selected for the Site. Nobis Engineering, Inc. (Nobis) supported EPA in completion of the review under EPA Contract No. EP-S1-06-03, Task Order No. 0029-FR-FE-0162.

## 2.0 SITE CHRONOLOGY

This section contains a table that presents the Site historical events in chronological order to outline the decisions made that led to the selection of the cleanup remedy for the Site.

**Table 2-1  
Chronology of Site Events**

<b>Event</b>	<b>Date</b>
Discovery of the problem	October 1982
South Municipal Water Supply Well shut down	December 1982
Final listing on National Priorities List (NPL)	September 21, 1984
Remedial Investigation/Feasibility Study complete	September 27, 1989
ROD signature	September 27, 1989
Effective date of Unilateral Order to New Hampshire Ball Bearing, Inc. to implement remedy	July 9, 1990
First ESD addressing air emission controls and sediment excavation	May 6, 1993
Construction start	June 7, 1993
Start of groundwater treatment plant operation	March 12, 1994
Start of vacuum extraction system	October, 1994
Construction completion (wetlands restored)	December 15, 1994
Second ESD addressing technical impracticability waiver resulting in elimination of need for several extraction wells and soil vapor extraction	February 3, 1997
First Five-Year Review Report	June 2, 1998
Extraction well (EX-7) in dilute plume shut down	November 17, 1998
Extraction well EX-10 began operation	May 16, 2002
Second Five-Year Review Report	June 2, 2003
South Well Pumping Test	October 6, 2003 through February 3, 2005
Source Area Delineation	December 15, 2006 through February 6, 2007
Additional Source Area Delineation	April 2008
Third Five-Year Review Report	August 2008

### **3.0 BACKGROUND**

The following sections describe the Site characteristics, land and resource use, Site history, initial response onsite, and the basis for implementing the cleanup action.

#### **3.1 Physical Characteristics**

The Site has been defined to include the South Municipal Water Supply Well (South Well), a portion of the Contoocook River, the adjacent wetlands, and the New Hampshire Ball Bearing (NHBB) property which is located approximately two miles south of the center of the town of Peterborough in Hillsborough County, New Hampshire. The South Well, situated at the edge of the Site, is located on Sharon Road, approximately 350 feet east of the Contoocook River. The NHBB facility is situated approximately 1,200 feet northwest of the South Well and approximately 800 feet west of the Contoocook River. The Site area is approximately 250 acres.

The NHBB property currently consists of an active manufacturing facility, asphalt parking lots, the groundwater treatment system, and sedge meadow wetlands. U.S. Route 202, the abandoned Boston & Main (B&M) Railroad which runs parallel to Route 202, and Sharon Road all cut north-south through the Site. Refer to Figure 1 in Appendix A (provided by NHBB's contractor, Hull & Associates, Inc. (Hull), for the purpose of this five-year review) for Site features.

Four major surface water features have been identified at the Site including the aforementioned sedge meadow, a shallow marsh, the Contoocook River/Noone Pond system, and its associated deep marsh. The sedge meadow drains into a shallow marsh located north of the NHBB property. These features in turn drain into the Contoocook River/Noone Pond system located east of Route 202 through culverts under the former B&M Railroad lines and Route 202. An unnamed creek runs easterly across the northern edge of the NHBB property and drains into the sedge meadow wetlands located between the eastern edge of the NHBB's northeastern parking lot and Route 202.

The Site is situated in the Contoocook River Valley, on glacial/fluvial deposits approximately 20 to 90 feet in thickness. Deposits are predominantly sands and gravels, although silty layers are found dispersed both vertically and horizontally about the Site area. The general direction of

groundwater flow is east-northeast in the vicinity of the NHBB plant and changes to a northerly direction at the Contoocook River, paralleling the river. The groundwater velocities are high, due to the coarse media and the large gradients.

### **3.2 Land and Resource Use**

Land use in the vicinity of the Site, particularly east of the river, is rural and undeveloped. A plumbing business and several apartments are situated on the property adjacent to, and south of, the South Well (Figure 1, Appendix A). Approximately 1,000 feet north of the South Well and west of the river are an automobile dealership and several commercial establishments. NHBB, a manufacturer of precision ball bearings, is located approximately 1,200 feet west of the South Well.

The Site and adjacent area are served by a municipal water system which receives water from three wells located north of the town center. The closest residential wells are located approximately one-half mile north and upgradient of the Site. A private sand and gravel company is drawing groundwater from a well located several hundred feet south of the South Well. The South Well was installed in 1952 and provided water to the town of Peterborough for thirty years.

### **3.3 History of Contamination**

On October 22, 1982, the New Hampshire Water Supply and Pollution Control Commission (now the New Hampshire Department of Environmental Services) found over 100 parts per billion (ppb) of total volatile organics in a sample of water from the South Well. At the recommendation of the EPA and the state, the town of Peterborough discontinued the use of the South Well. Subsequent investigations determined that solvent use and disposal at the NHBB facility had resulted in a plume of contaminated groundwater extending from under the NHBB property to the vicinity of the South Well. The principal solvents NHBB had used and detected in the groundwater were tetrachloroethylene (PCE), trichloroethylene (TCE), and 1,1,1-trichloroethane (1,1,1-TCA).

### **3.4 Initial Response**

EPA and NHBB completed a Remedial Investigation and Feasibility Study (RI/FS) to assess the extent of contamination and evaluate remedial alternatives in 1989. In September 1989, a ROD was signed by the EPA Regional Administrator that selected a remedy for the Site.



### **3.5 Basis for Taking Action**

EPA selected a remedy for the Site based on the discovery of two media with contaminants which posed unacceptable risks to public health and the environment: 1) groundwater containing volatile organic solvents (PCE, TCE, 1,1,1-TCA); and 2) wetland sediments located on the NHBB property containing polychlorinated biphenyls (PCBs) and polyaromatic hydrocarbons (PAHs). The principal threats were from ingestion of contaminated groundwater and direct contact and incidental ingestion of contaminated sediments.

## **4.0 REMEDIAL ACTIONS**

This section describes the remedial actions selected for and implemented at the Site as described in the ROD and subsequent Explanations of Significant Differences (ESDs).

### **4.1 Remedy Selection**

The remedial action objectives which were presented in the ROD issued September 27, 1989 were to:

- Eliminate or minimize, to the maximum extent practicable, the threat posed to the public health, welfare, and environment by the current extent of contamination for groundwater, soils, and sediments;
- To eliminate or minimize the migration of contaminants from the soils into the groundwater; and
- To meet federal and state ARARs.

To meet these objectives, the ROD included the following components:

- Groundwater Extraction and Treatment with Air Stripping and Carbon Columns for Air Emission Control
- In-Situ Vacuum Extraction of Contaminated Soils
- Excavation and/or Dredging with Dewatering of Sediments and Off-Site Disposal
- Wetlands Restoration
- Long-Term Environmental Monitoring
- Institutional Controls
- Five-Year Reviews

Between July 1990 and January 1993, extensive pre-design investigations were undertaken and the design of the remedy finalized. As a result of having obtained more detailed technical information during these pre-design investigations, an ESD was issued on May 6, 1993, which documented modifications to the remedy principally for air emission controls and sediment excavation.

The May, 1993, ESD determined that excavation of sediments was appropriate, but that a small area of contaminated sediments would be left in place and monitored. The ESD also documented the decision: 1) to remove the requirement for air emission control; 2) to use air sparging to attempt to enhance dense non-aqueous phase liquid (DNAPL) removal; and 3) to allow natural attenuation of a small portion of the leading edge of the contaminated plume.

The groundwater extraction and treatment system has been in operation since March of 1994 and the in-situ vacuum extraction system began operation in October of 1994. After reviewing quarterly groundwater sampling data over the first two years of operation and considering the changes which had occurred since the ROD was issued, the EPA determined that it was technically impracticable to restore the portion of the contaminated groundwater affected by DNAPL to drinking water quality in a reasonable time frame. Therefore, a second ESD was issued on February 3, 1997 which documented EPA's decision to waive certain Federal Drinking Water Standards which are ARARs for groundwater within the "technical impracticability (TI) waiver area". As shown on Figure 1 in Appendix A, the "TI waiver area" includes the NHBB property from 50 feet west of the centerline of Route 202 and to the north of a line running from the entrance to the parking lot to just south of well EM-107. The "TI waiver area" applies to both the overburden and bedrock aquifers.

Based on the determination of technical impracticability, three elements of the remedy were modified in the second ESD in 1997:

- 1) In-Situ Vacuum Extraction of Contaminated Soils

Since no soil contact threat was identified, the ROD prescribed an in-situ vacuum extraction system to remediate soils located near the corner of the NHBB facility solely to allow attainment of groundwater cleanup levels. This ESD eliminated the need to meet the remedial action

objective (RAO) dealing with soil contamination. With the groundwater ARARs waived as part of the 1997 ESD, vacuum extraction was discontinued.

## 2) Air Sparging

The ROD stated that it might be necessary to implement technologies to enhance contaminant removal and to address the presence of free phase solvents in the saturated zone of the NHBB area plume. Air sparging (in conjunction with the in-situ vacuum extraction system) was the selected technology. However, it was never operated due to technical problems encountered in implementing the air sparging system and groundwater ARARs being waived as part of the 1997 ESD.

## 3) Groundwater Extraction

The ROD specified that the groundwater extraction system for the NHBB area would be designed to create a hydraulic barrier between the NHBB area plume and the rest of the aquifer. Since ARARs were waived as part of the 1997 ESD, the pumping rates and the extraction well configuration was changed to maintain the hydraulic barrier between the NHBB area plume and the rest of the aquifer for contaminant containment and not to attempt to restore the NHBB area plume to drinking water quality within the "TI waiver area".

### **4.2 Remedy Implementation**

A Unilateral Administrative Order for the design, construction, operation and maintenance of the groundwater extraction remedy became effective on July 9, 1990. NHBB, the party potentially responsible for the contamination, completed the design of the remedy which was approved by EPA on May 3, 1993. Construction began on June 7, 1993. The groundwater extraction and treatment system began operation in March of 1994 and has operated since then. The in-situ vacuum extraction system began operation in October of 1994 but ceased operation in 1997 when the second ESD was issued (see above).

In 1994, all sediments were removed and disposed of at a secure landfill operating in compliance with the Resource Conservation and Recovery Act (RCRA). A pre-final inspection was held on September 27, 1994, with a follow-up inspection held October 20, 1994, to ensure

completion of the sediment removal and backfilling. Backfilling with enriched, hydric soils and replanting was completed on November 5, 1994.

Monitoring of groundwater quality and water levels has continued throughout the remedial design, construction and post-construction phases. In the fall of 1998, an analysis of the data indicated that cleanup levels had been achieved and maintained for the previous three years in that portion of the dilute plume being captured by extraction well EX-7 located between Route 202 and the Contoocook River. As a result, EX-7 was turned off and that portion of the aquifer, from just east of Route 202 to just west of EX-5A has continued to meet the cleanup levels without the use of EX-7. On October 9, 2000, extraction well EX-5A was shut down as part of an ongoing investigation into persistent volatile organic compound (VOC) concentrations near the leading edge of the plume. Based on the VOC concentrations, NHBB resumed pumping at EX-5A on April 9, 2003 to remove the contamination from the dilute plume.

A long term, three stage pumping test was performed by NHBB and the town of Peterborough on the South Well, in conjunction with the operation of the extraction well containment/remedial system, from October 6, 2003 through February 3, 2005 to determine if reactivation of the South Well was feasible. Prior to the pumping test, the combination of extraction wells EX-4 and EX-10 (pumping at approximately 94 gpm) appeared to be containing the contamination in the "TI waiver area". Extraction wells EX-1 and EXH-3 were reactivated after the pumping test in June 2006 to alleviate the contaminant loading on the primary containment wells (EX-4 and EX-10). VOC concentrations in the "TI waiver area" had rebounded to or were approaching pre-remedial conditions. However, it appeared that a decline in VOC concentrations in the "TI waiver area" had occurred since the reactivation of EX-1 and EXH-3. VOC concentrations in the dilute plume (outside the "TI waiver area") are less than cleanup criteria (pre-South Well pumping test) except for monitoring well MW-5B.

The cleanup goals for groundwater, developed in response to the first RAO, along with the maximum levels of contaminants found in monitoring wells outside the "TI waiver area" are presented in Table 2, below. Refer to Figure 1 in Appendix A for monitoring well locations.

**Table 4-1**  
**Groundwater Cleanup Goals and Results for the Dilute Plume**

Contaminant	Target Level (ppb)	2003-2007 Maximum/Well No.	Most Recent Maximum/Well No.
Tetrachloroethylene (PCE)	5	51 ppb/MW-5B	31 ppb/MW-5B
1,1,1-Trichloroethane (1,1,1-TCA)	200	72 ppb/MW-11L	15 ppb/MW-5B
Trichloroethylene (TCE)	5	45 ppb/MW-5B	27 ppb/MW-5B
1,1-Dichloroethylene (1,1-DCE)	7	3 ppb/RP-1	2 ppb/MW-5B
Toluene	2000	< 6 ppb/MW-11L	< 3 ppb/MW-5B
1,1-Dichloroethane (1,1-DCA)	810	7 ppb/MW-5B	4 ppb/MW-5B
Vinyl Chloride	2	< 6 ppb/MW-11L	< 1 ppb/MW-5B

#### **4.3 System Operations/Operation and Maintenance (O&M)**

There are two principal aspects to the O&M for this remedy: groundwater treatment facility O&M and extraction well O&M.

##### Groundwater Treatment Facility

The groundwater extraction and treatment system has been in operation for the past fourteen years beginning in March of 1994. This five year review includes Years 10 through 14 (2003 through 2007) of operation. The system has been consistently operating with interruptions only for routine maintenance and modifications to the process. Approximately 1.65 billion gallons of water have been extracted and treated by the groundwater treatment plant through March 2007. Annual totals were generally less than initial years because fewer wells are in service. In the past five-year period approximately 351 million gallons of water have been treated. Currently, the average flow rate of the operating extraction wells is approximately 165 gallons per minute (gpm).

System effluent water (surface water discharge) analytical results were generally 10 ppb or less of total VOCs concentrations, within the compliance limit of 100 ppb total VOCs. Approximately 8,833 pounds of VOCs (685 gallons) have been removed over the past 13 years (6,233 pounds of PCE, 1,829 pounds of 111-TCA, 777 pounds of TCE). Tables 12 and 14 from the *Annual Groundwater Monitoring Report – Year 13* (Hull, 2007a), located in Appendix B, present annual and cumulative gallons of groundwater and amounts of VOCs removed, respectively.

Removal efficiency of Tower 2 air stripper ranged from 83% to 99.9% of VOCs during the period since 2003 (year 2007 data not available). Efficiencies on the lower end of the range generally coincided with times prior to tower packing change outs. Air stripper tower cleaning is performed using citric acid solution when pressure differentials get to be too great and/or the removal efficiency declines.

Air emission concentrations ranged from 0.18 lbs/day (0.89 mg/m<sup>3</sup>) to 0.83 lbs/day (1.52 mg/m<sup>3</sup>). This result range was observed during Year 13 (2006) of operation; previous years were within this range.

#### Extraction Well O&M

There are currently five groundwater extraction wells operating at the Site (see Figure 1). Extraction wells EX-4 and EX-10 are located on NHBB property and are operated to contain contaminated groundwater within the "TI waiver area" on NHBB property. Clogging problems in EX-4 resulted in the installation of EX-10. With both wells pumping (total flow in excess of 100 gpm when operating at full capacity), containment is ensured without other external pumping occurring. Extraction wells EX-4 and EX-10 have biofouling issues which decrease the flow rate capacity of each well. Low yield and/or excessive drawdown in these wells have been the signal to clean the wells (see below).

Extraction well EX-5A is located at the leading edge of the groundwater contamination, east of Sharon Road. After an extended evaluation period during which the well was not being used, it has been reactivated (beginning in April 2003) in order to remove the contamination from the dilute plume outside the "TI waiver area" for treatment at the treatment plant. The pumping rate is set at greater than 40 gpm.

Extraction wells EX-1 and EXH-3 are located on the NHBB property and were reactivated the week of June 26, 2006 to provide mass removal and alleviate the contaminant loading on the primary containment wells (EX-4 and EX-10). EX-1 and EXH-3 are referred to as the "interim remedial action" wells. The current pumping rates are set at 25 and 30 gpm for each well, less than the previous pumping rates achieved by these wells when in operation prior to their deactivation on June 26, 1997. Both extraction wells operated from the week of June 26, 2006 through December 1, 2006 when their operation was suspended to allow for source area

delineation activities. Operations of extraction wells EX-1 and EXH-3 commenced following completion of the source area delineation activities in 2007.

Routine maintenance of the extraction system includes removal of the extraction well pumps for cleaning purposes. Aerobic and anaerobic bio-fouling with iron and manganese consistently occurs in the pumps and lines associated with extraction wells EX-4 and EX-10. Cleaning of the pumps has been modified by altering the cleaning chemicals used and the residence time during which the pumps are submerged.

The production loss due to biofouling in EX-4 and EX-10 was evaluated and it was determined that the chemical makeup of the hydrochloric and phosphoric acid blend solution used to clean the pumps and piping provided a nutrient source for the bacteria. This nutrient source resulted in the persistent biofouling of the equipment. It was recommended that a glycolic acid and hydrochloric acid dosing be utilized to adjust the pH and to disinfect the equipment, well, and sand pack. The dispersant agent would be introduced to the well and stand for 24 hours prior to mechanical pumping and cleaning until the discharge water was relatively clear of silt. NHBB implemented the rehabilitation protocols in spring 2007 which included the redevelopment of EX-4 and EX-10 until the discharge water produced nearly silt free water. This was performed twice in 2007.

However, according to Ms. Patricia Carrier, Facilities/Environmental Manager for NHBB, the modified method of cleaning the pumps has not reduced the amount or frequency of biofouling. Biofouling still occurs approximately every three months following pump cleaning, thereby reducing flow rates. However, the specific yield of extraction wells EX-4 and EX-10 initially increased with the redevelopment of the wells. Pump cleaning is generally performed in six-month intervals.

## **5.0 PROGRESS SINCE THE LAST FIVE-YEAR REVIEW**

This is the third five-year review for the Site. The second five-year review contained two recommendations for ensuring the protectiveness of the remedy. The status of their implementation is presented below.

#### Recommendation/Follow-up Action 1

*Implement a preventative maintenance schedule for the extraction wells prior to reactivation of the South Well.*

Over the past five years, the groundwater treatment system extraction wells were cleaned at least twice a year and three times in 2005. In 2006, NHBB evaluated the production losses observed at extraction wells EX-4 and EX-10. See Section 4.3 for the results of the evaluation. Pump cleaning is generally performed in six-month intervals and will continue on this schedule.

#### Recommendation/Follow-up Action 2

*Groundwater monitoring should continue quarterly for wells near EX-5A and annually for all other wells. The samples should include analysis for 1,4-dioxane.*

Groundwater monitoring was conducted in 2003 through 2006 as recommended in the previous five-year review with annual monitoring for the full set of designated wells and quarterly monitoring for the wells associated with extraction well EX-5A. Sampling was not performed quarterly in 2007 as in past years due to the ongoing activities for the source area delineation. Since pumping resumed at EX-5A, no VOCs have been detected above cleanup levels except in monitoring well MW-5B.

1,4-Dioxane was included in the analyses of groundwater monitoring samples collected during 2003 through 2005. It was detected in two of 19 samples collected in June 2003. The detected samples were obtained at GZ-13R and EX-4. 1,4-Dioxane was subsequently analyzed for and detected at GZ-13R in September 2003, December 2003, March 2004, July 2004, October 2004, and January 2005; and analyzed for and detected at EX-4 in July 2004. Detected concentrations ranged from 0.62 micrograms per liter ( $\mu\text{g/L}$ ) to 4.8  $\mu\text{g/L}$ . There are no federal drinking water standards for 1,4-dioxane. New Hampshire Code of Administrative Rules lists an Ambient Groundwater Quality Standard (AGQS) for 1,4-dioxane of 3  $\mu\text{g/L}$ . The June 2003 and July 2004 samples collected from EX-4 exceeded this value; however, EPA Region 6 Medium specific human health screening values and EPA Region 9 preliminary remediation goals have published screening values for 1,4-dioxane of 6.1  $\mu\text{g/L}$  corresponding to cancer risk level of  $1 \times 10^{-6}$  under a drinking water scenario. Because detected concentrations at EX-4 (within the TI



Waiver area) are less than these risk-based screening values, risks from 1,4-dioxane are considered to be acceptable and no further analyses for 1,4-dioxane are recommended for the Site.

## **6.0 FIVE-YEAR REVIEW PROCESS**

This section provides a summary of the five-year review process and the actions taken by EPA to complete the review.

### **6.1 Administrative Components**

EPA, the lead agency for this five-year review, issued a scope of work, Task Order No. 0029-FR-FE-0162, to Nobis, under EPA RAC 2 Contract No. EP-S1-06-03, on March 24, 2008, to assist EPA in performing the five-year review. The EPA Task Order Project Officer was Richard Goehlert. Thomas Andrews, Remedial Project Manager for the New Hampshire Department of Environmental Services (NHDES), was part of the review team. NHBB provided figures, tables and charts for data presentation.

### **6.2 Community Notification and Involvement**

The community was notified of the start of the third five-year review via an EPA notice published in the Monadnock Ledger-Transcript on March 4, 2008. A copy of the notification is in Appendix D.

The town of Peterborough remains involved with NHBB in activities that are performed at the Site and working towards the reopening of the South Well. The general public has not taken an interest in the Site assumedly since the Site is not located in a highly residential area or affecting many individuals off-site. The business across Shannon Street, SDE, Inc. - Staff Development for Educators (SDE), where extraction well EX-5A is located, is involved when Site activities require property access. SDE has expressed an interest in being more informed (see Section 6.6).

Copies of all documents pertaining to the Site, including this five-year review, are provided to the town of Peterborough as well as the Peterborough Public Library to be placed in the information repositories for public access.

Interviews were conducted with select individuals at the town of Peterborough as well as SDE. These are identified in Appendix C and discussed in Section 6.5 below.

### **6.3 Document Review**

This five-year review consisted of a review of relevant documents including decision documents and monitoring reports. The documents reviewed are listed in Appendix E.

### **6.4 Data Review**

Records and annual groundwater monitoring reports (Years 10 through 13) were reviewed for this report. Sampling was not performed quarterly in 2007 (Year 14) as in past years due to the ongoing activities for the source area delineation (Section 7.1.1). A discussion of the data review is included in the technical assessment presented in Section 7.0.

### **6.5 Site Inspection**

A Site inspection was conducted on May 1, 2008, with representatives from the EPA, NHDES, Nobis, and NHBB. The inspection of the groundwater extraction and treatment system included a review of the groundwater extraction/treatment process and inspection of the equipment within the process building. The outdoor portion of the inspection included the wetland; extraction wells EX-4, EX-5A (SDE facility), and EX-10; monitoring well cluster MW-16; and the South Well. No problems/issues were observed. The Site Inspection Checklist is in Appendix F.

### **6.6 Interviews**

General discussions and observations were documented during the Site inspection on May 1, 2008. Telephone interviews were also completed to supplement the Site inspection interviews. The list of individuals interviewed regarding this five-year review is shown in Appendix C. The following paragraphs summarize their interviews.

Mr. Ron Bowman of SDE was interviewed at the SDE facility by NHDES and EPA on April 15, 2008. Mr. Bowman feels that the remedy is being maintained since the treatment plant is still operating and he observes the monitoring that is implemented at NHBB and on the SDE property at EX-5A. SDE went through a 120% expansion in 2003 including the building, parking areas and driveways. Mr. Bowman does not anticipate any further expansion on the property since town zoning limits further building expansion. SDE would support the town for the return of the South Well as a drinking water source if needed to provide additional water.

Also, SDE would like to be kept informed of actions at NHBB concerning remedial activities and cleanup progress, although it is known that data and information is available at the town.

Ms. Patricia Carrier, Facilities/Environmental Manager for NHBB, attended the Site inspection and was also contacted by phone on May 13, 2008. Ms. Carrier indicated that maintenance of the "TI waiver area" extraction wells (EX-4 and EX-10) is an on-going issue. The company is still actively pursuing alternatives to deal directly with the source of contamination. A source area delineation investigation was performed to aid in an alternative selection. In addition to investigating remedial alternatives, NHBB is also evaluating the need for further vapor intrusion investigations in the NHBB facility.

Mr. Tom Andrews, Waste Management Division of the NHDES, attended the site visit. Mr. Andrews was in agreement with everything Ms. Carrier expressed during the Site visit. He stated that NHBB is currently working towards pursuing alternative remedial technologies so that the South Well may be operable again in the future. Mr. Andrews also expressed that NHBB, the town of Peterborough, EPA and NHDES are all working together amicably.

Mr. Rodney Bartlett, the town of Peterborough's Director of Public Works, was interviewed at the town offices on May 1, 2008, and indicated that the town is still interested in the use of the South Well as a municipal supply well at a pumping rate of approximately 400 to 500 gpm. Another well (Hunt Well) is also being evaluated for pumping at approximately 200 gpm. The Hunt well has an iron and manganese issue so; the use of both wells is anticipated. Due to the results of the pumping test, Mr. Bartlett feels that the remedy is not functioning as expected. He is aware that efforts are being made to establish an alternative for remediation of the source contamination.

Mr. Lance Turley and Ms. Tracy Edwards, Hull & Associates, Inc. (NHBB consultant), were contacted by telephone on May 8, 2008. Their response collaborated sentiments provided by Ms. Carrier in respect to the ongoing evaluation of remedial alternatives of the source contamination as well as vapor intrusion in the NHBB facility. Hull's sense on the effectiveness of the remedy is that it has the ability for containment under initial conditions, but that biofouling of the containment wells may affect this. Mr. Turley mentioned that the NHBB facility was expanded in the past five years. However, the expansion did not have an effect on the remedial activities.

Ms. Pam Brenner, the town of Peterborough's town Administrator, was contacted by telephone on May 21, 2008. She expressed frustration over the lack of progress over the past five years towards cleanup and that it is time to work towards treating the source. Due to the results of the pumping test, Ms. Brenner feels that the remedy is not functioning as expected. The town of Peterborough would like to see the reuse of the South Well. Ms. Brenner conveyed that there is currently no water source in the south aquifer. The only current source of water is in the north aquifer. If the north water source were to be compromised in some manner, the town of Peterborough would have no water source.

## **7.0 TECHNICAL ASSESSMENT**

This section provides a technical assessment of the RA that is being implemented at the Site. This third five-year review follows the Comprehensive Five-Year Review Guidance (EPA, 2001) and was developed to answer the questions below.

### **7.1 Question A: Is the Remedy Functioning as Intended by the Decision Documents?**

No, the remedy is not functioning as intended by the decision documents. The review of Site-related documents, data representing the last five years (2003 through 2007), O&M procedures, ARARs, and Site inspection notes indicate that the remedy is not functioning as intended by the ROD and subsequent ESDs. In order to restore the use of the aquifer beyond the "TI waiver area" for water supply purposes and reactivation of the South Well, evaluation of additional remedial technologies, or combination thereof with containment at the NHBB property line/"TI waiver area", should be performed and implemented to target source areas within the "TI waiver area". In addition, as noted in Section 7.1.5 below, reestablishment of the aquifer protection zoning overlay district that has recently not been maintained by the town needs to be reinstated for the remedy to be protective in the short term.

The remedy was evaluated for whether the Performance Standards are met (Section 7.1.1) and the O&M is conducted (Section 7.1.2).

### **7.1.1 Remedial Action Performance**

#### **South Well Pumping Test**

From October 6, 2003 through February 3, 2005, a long term, three stage pumping test was performed on the South Well in conjunction with the operation of the extraction well containment/remedial system to determine if reactivation of the South Well was feasible.

Overall results of the pumping test indicated that the containment system (extraction wells EX-4 and EX-10) performed as anticipated up to pumping rates of approximately 100 gpm at the South Well, sustained for durations of 24 hours per day. However, the test demonstrated that the capacity of the containment system to capture all portions of the contaminant plume is exceeded when operating the South Well 24 hours per day at approximately 150 gpm (Hull, 2005b). Extraction wells EX-4 and EX-10, in conjunction with the South Well, were pumping at a combined rate of approximately 244 gpm. The containment system's performance was associated with limited pumping rates for EX-4 and EX-10 due to the biofouling of the well screens. Measurable concentrations of VOCs were detected in the early warning wells in the third stage of the test when the South Well was operated 24 hours per day at approximately 150 gpm. Concentrations equal to or above cleanup levels were detected in early warning well GZ-13M and monitoring well MW-11L (see Figure 1). The original goal of the pumping test was to gradually increase operation of the South Well up to 300 gpm. More recently, the town of Peterborough expressed that they would like to utilize the South Well at a rate of approximately 400 to 500 gpm. Since the town requires the South Well to be pumped at a rate much higher than 150 gpm (where the capacity of the containment system to capture all portions of the contaminant plume is exceeded), the protectiveness of the remedy would be affected when operating both the South Well and the extraction wells.

Prior to the pumping test, the combination of extraction wells EX-4 and EX-10 pumping at approximately 66 gpm and 32.2 gpm, respectively, were containing the contamination in the "TI waiver area". Extraction wells EX-1 and EXH-3 were reactivated after the pumping test in June 2006 to alleviate some of the contaminant loading on the primary containment wells (EX-4 and EX-10). Thirty-five compliance wells (monitoring wells and extraction wells EX-4, EX-10, and EX-5A) were sampled in December 2006 just prior to the source area delineation (see below). Only two contaminants of concern (COC) did not meet their specified cleanup levels outside the

“TI waiver area”. The PCE Maximum Contaminant Level (MCL) of 5 ppb and the TCE MCL of 5 ppb were exceeded in monitoring well MW-5B. VOC concentrations in the dilute plume are less than cleanup criteria (pre-South Well pumping test) except for monitoring well MW-5B. VOC concentrations in the “TI waiver area” had rebounded to or were approaching pre-remedial conditions. However, it appears a decline in VOC concentrations within the “TI waiver area” has occurred since the reactivation of EX-1 and EXH-3.

#### Source Area Delineation

Following the pumping test, a source area delineation investigation was performed to gain a better understanding of the extent and distribution of VOCs near two source areas, former Outfalls 002 and 003A (Figure 1, Appendix A). Sampling results show that PCE is the main component of the VOC plume. DNAPL has been confirmed near the northeast corner of the NHBB facility. Dissolved phase VOC concentrations are: 1) in excess of 100 µg/L in an area approximately 500 feet by 200 feet between the northeast corner of the NHBB facility and the wetlands; 2) present in the upper 50 feet of the aquifer at concentrations exceeding 1,000 µg/L; and 3) present throughout the aquifer to depths of 77 feet below ground surface (bgs) and 60 feet bgs near the NHBB facility and wetlands at concentrations greater than groundwater MCLs. VOC concentrations which define residual DNAPL are coincident with the former 1955 stream bed associated with the discharge from former Outfall 003A. Former Outfall 002 is another source of residual DNAPL near the western edge of the wetland. Contaminant flux from dissolution as groundwater moves through DNAPL residuals has caused elongation of the dissolved phase plume parallel to groundwater flow (Hull, 2007b). Figure 2 in Appendix A (provided by NHBB’s contractor, Hull, for the purpose of this five-year review) shows the extent of the groundwater plume.

The distribution and transport mechanisms of contaminants in groundwater associated with former Outfalls 002 and 003A have been sufficiently investigated to begin evaluation of alternative remedial technologies with the exception of VOC concentrations detected in samples collected from vertical point VP-17. Alternative remedial technologies focused on source reduction will be addressed in a Focused Feasibility Study (FFS) to be completed in the future (Section 9.0). NHBB has prepared a work plan for the FFS detailing an initial screening of potential remedial technologies (Hull, 2008). Tables 1 and 2 from the work plan summarize the pre-screened remedial technologies and are included in Appendix G.

VP-17 was installed during the source delineation to define the northern boundary of VOC concentrations historically observed in the GZ-104 well cluster (Hull, 2007b). Residual PCE concentrations greater than 5,000 µg/L, the project objective for defining the horizontal limits of the plume, were detected in VP-17 as well as elevated concentrations of dissolved phase TCE and 1,1,1-TCA. There are no control points west of VP-17 to determine if elevated PCE concentrations are isolated to the plume or part of the plume body (Hull, 2007b). Also, it is unknown if the dissolved phase contaminants have migrated to the adjacent property that borders the NHBB facility to the north. See Section 7.3 for additional source delineation data introduced on June 3, 2008 concerning an investigation into the contamination detected at the NHBB facility in the area of vertical point VP-17.

In addition, as part of the source area delineation, northern perimeter wells were installed, a biofouling assessment was performed, and inhalation exposure pathways were investigated. Northern perimeter monitoring wells MW-16U, MW-16M and MW-16L (MW-16 cluster) were installed to determine if there was a northern flow component allowing VOCs to migrate around the containment system and contribute to the persistent VOC concentrations observed in MW-5B. Analysis of potentiometric surfaces and flow patterns using water level data from the MW-16 cluster indicates that the MW-16 cluster is within the capture zone of EX-4 and EX-10 at present pumping rates (Hull, 2007b).

Biological and geochemical data were collected as part of the source area delineation to supplement on-going biofouling evaluations of extraction wells EX-4 and EX-10. Biological Activity Reaction Test (BARTs™) field testing kits and supplemental inorganic geochemical testing were performed on select monitoring wells. Water quality parameters were also collected from each vertical profiling sample interval. See Section 4.3 for additional actions taken to alleviate the biofouling in extraction wells EX-4 and EX-10.

Sub-slab vapor data was collected for worker safety during drilling of vertical points within the NHBB facility. Elevated vapor concentrations of select VOCs were detected and compared to the screening values published in the 2006 NHDES Vapor Intrusion Guidance. Concentrations of PCE, TCE, 1,1,1-DCE, 1,1,1-TCA and methylene chloride beneath the building exceed the NHDES commercial screening values. This indicates the potential for exposure to VOCs volatilizing from soil to groundwater to indoor air (Hull, 2007b).

### **7.1.2 System Operations/O&M**

The extraction well containment/remedial system operations are effective in ensuring that containment is achieved and VOC concentrations in the dilute plume remain below cleanup concentrations without the reactivation of the South Well. The biofouling of the well screens in extraction wells EX-4 and EX-10 limits their ability to maintain the capture zone sustained when the South Well is operational, as seen during the third stage of the pumping test. NHBB evaluated the production losses observed at extraction wells EX-4 and EX-10 (see Section 4.3) and recommended an alternative cleaning protocol that was performed twice in 2007. According to NHBB, the modified method of cleaning the pumps has not reduced the amount or frequency of biofouling. Biofouling occurs approximately every three months following pump cleaning, reducing flow rates. However, the specific yield of extraction wells EX-4 and EX-10 initially increased with the redevelopment of the wells.

### **7.1.3 Opportunities for Optimization**

In order to improve performance of extraction wells EX-4 and EX-10, alternatives to the present cleaning protocols that have been utilized should continue to be investigated (see Section 4.3).

### **7.1.4 Early Indicators of Potential Remedy Problems**

The results from the South Well pumping test serve as an early indicator that the current remedial actions will not be protective of the remedy if the South Well were to be reactivated in the future.

### **7.1.5 Implementation of Institutional Controls**

An Administrative Order (Docket #: CERCLA I-90-1074) was filed at the Hillsborough County Registry of Deeds (Book 5199, Page 1414) on July 16, 1990 by the EPA to ensure that the remedial action outline in the ROD will be completed. An inspection of the deed on May 13, 2008 at the website of the Hillsborough County Registry of Deeds confirms that this Administrative Order has been maintained.

A deed restriction was filed at the Hillsborough County Registry of Deeds (Book 6171, Page 1713) on October 21, 1999 to restrict the use of the groundwater on the NHBB property. An inspection of the deed on May 13, 2008 at the website of the Hillsborough County Registry of Deeds confirms that this Administrative Order has been maintained.



An aquifer protection zoning overlay district (Aquifer Protection District D) was established by the town of Peterborough for the Site in the Peterborough Code (Code), Chapter 245 Zoning to disallow groundwater use throughout the Site. The boundary has been set approximately 1,000 feet beyond the extent of contamination as determined by chemical analyses of the groundwater at the Site. The zoning overlay was present in the Code dated March 12, 2002. However, the zoning overlay was not maintained when the Code was revised as of March 2005. The oversight was not discovered in time to have the zoning overlay reinstated in 2008. The matter will be revisited by the town of Peterborough in 2009. Until that time, the institutional control set in place by the ROD is no longer functioning and affects the protectiveness of the remedy.

**7.2            Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives (RAOs) Used at the Time of the Remedy Selection Still Valid?**

Yes, the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection are still valid.

Changes in Land Use of the Site and Physical Site Conditions

At the time of the ROD signing in 1993, the Site was an active manufacturing facility surrounded by mostly vacant property with a business and residence across Sharon Road. Fifteen years later the site description under Section 3.1 above remains the same with no site feature impacts on the RA. There have been no changes in land use at or near the Site that would change the exposure assumptions contained in the ROD or affect the protectiveness of the remedy. A private "bottled water company" was identified in the 2003 five-year review which uses a private well located approximately 1,400 feet south of the South Well to draw groundwater for bottled water purposes. The 2003 five-year review stated that the rate of pumping is insufficient to impact the Site and the effectiveness of the remedy. The re-use of the South Well aquifer remains a goal of the town.

## Changes in ARAR Standards and To Be Considered

The following ARARs were reviewed for changes that could affect protectiveness:

- Safe Drinking Water Act (40 CFR 141.11-141.16) from which many of the groundwater cleanup levels were derived - [MCLs, and MCL Goals (MCLGs)];
- Resource Conservation and Recovery Act (40 CFR 264);
- Clean Water Act (40 CFR 122); and
- New Hampshire Code of Administrative Rules - Drinking Water Quality Standard (Env-Ws 315.01) and AGQS (Env-Or 603.03).

The ROD identified chemical specific ARARs for the Site for seven indicator compounds (PCE, 1,1,1-TCA, TCE, 1,1-DCE, toluene, 1,1-DCA, and vinyl chloride). As part of the 1997 ESD, groundwater ARARs were waived for the "TI waiver area". However, groundwater ARARs remain in effect for areas outside of the "TI waiver area". Additionally, target soil cleanup values (vadose zone contaminated soils, not wetland sediments), which were based on groundwater protection, became unnecessary within the "TI waiver area" once the groundwater ARARs were waived and the vacuum extraction of contaminated soils was discontinued as part of the 1997 ESD.

For groundwater in the dilute plume area (outside the "TI waiver area"), with the exception of toluene and 1,1-DCA, the cleanup levels identified in the 1989 ROD for five of the seven COC reflect the pertinent ARAR values of today: PCE - 5 ppb; 1,1,1-TCA - 200 ppb; TCE - 5 ppb; 1,1-DCE - 7 ppb; and vinyl chloride - 2 ppb. These levels are Federal MCLs, non-zero MCLGs, NH State Drinking Water Quality Standards, and NH State AGQS.

The 1989 ROD had identified a cleanup level of 2,000 ppb for toluene, which was the Federal MCLG at the time. This value has since been lowered to 1,000 ppb (Federal MCLG), a value also adopted in the New Hampshire Drinking Water Quality Standard (Env-Ws 315.01) and as an AGQS (Env-Or 603.03) in their code of Administrative Rules. Thus, the original value of 2,000 ppb for toluene cited in the 1989 ROD does not reflect the ARARs applicable today for the dilute plume portion of the Site where ARARs were not waived. Existing data for toluene in the dilute plume is below the Federal MCLG of 1,000 ppb.

With respect to 1,1-DCA, the cleanup level cited in the 1989 ROD (810 ppb) was not based on a Federal MCL/MCLG, but on a New Hampshire Department of Public Health Service consumption advisory for water supplies. As of today, EPA has not promulgated a Federal MCL or MCLG for 1,1-DCA nor has EPA issued a Health Advisory for this compound. NHDES however, has issued a New Hampshire Drinking Water Quality Standard (Env-Ws 315.01) and an AGQS (Env-Or 603.03) in their code of Administrative Rules for 1,1-DCA, both of which correspond to 81 ppb. Thus the original value of 810 ppb for 1,1-DCA cited in the 1989 ROD does not reflect the ARARs applicable today for the dilute plume portion of the Site where ARARs were not waived. Existing data for 1,1-DCA in the dilute plume is below the AGQS of 81 ppb.

With respect to soil cleanup levels (vadose zone contaminated soils, not wetland sediments) established in the 1989 ROD, these were completely negated with the 1997 ESD (which eliminated the need to meet remedial action objectives dealing with soil contamination) and thus there is no need to review changes to ARAR values for soils.

#### Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics

The exposure assumptions used to develop the baseline risk assessment, outlined in the RI/FS (EMTEK, 1989), included exposures associated with ingestion of groundwater as drinking water, direct contact with sediments, direct contact with soils, inhalation of airborne contaminants, direct contact with surface water, and ingestion of fish.

The vapor intrusion pathway was not evaluated in the original environmental assessment. The presence of sub-slab soil gas and shallow groundwater VOC concentrations below the northeast corner of the NHBB facility exceed EPA's OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils Table 2c, target groundwater concentrations, (EPA, 2002) for protection of indoor air indicating potential vapor intrusion concerns. No protection from exposures to volatile contaminants in shallow groundwater through the vapor intrusion pathway currently is in place within the "TI waiver area". Groundwater VOC concentrations outside of the "TI waiver area" (dilute plume) are for the most part below the drinking water standards used as cleanup levels, with the exception of monitoring well MW-5B. However, the drinking water standards are not designed to be protective of the vapor intrusion pathway. An evaluation of the vapor intrusion indoor air pathway has not been

performed on data collected outside of the "TI waiver area" in accordance with the EPA's OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils or the NHDES Vapor Intrusion Guidance. There is insufficient data to evaluate the protectiveness of the remedy based on the vapor intrusion pathway.

Groundwater concentrations exceeding drinking water standards at monitoring well MW-5B, which is outside the "TI waiver area", indicate that containment within the waiver zone has not yet been achieved. This well and other wells along the perimeter of the containment area represent the point of compliance where the goal is for concentrations to meet drinking water standards.

Institutional controls are currently not in effect (see Section 7.1.5). Town officials are aware of this lapse and anticipate reinstituting these controls in 2009.

Since the baseline risk assessment in 1989, EPA has re-evaluated toxicity factors for several of the indicator contaminants evaluated, including 1,1,1-TCA, TCE, vinyl chloride, toluene, and 1,1-DCE. Changes in these toxicity factors do not impact the remedy because of its reliance on institutional controls and drinking water standards; assuming the reinstatement of the aquifer protection zoning overlay district.

### **7.3      Question C: Has Any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?**

Yes, NHBB's consultant presented new data to the EPA on June 3, 2008 concerning an investigation into the contamination detected at the NHBB facility in the area of vertical point VP-17 during the source delineation (Section 7.1.1). Results of this investigation revealed previously unknown contamination above the drinking water standards outside the "TI waiver area". The source of the contamination is believed to be independent from the former Outfall 002 and 003A source areas. At this time, it appears that the contamination is limited in extent. It is not known if the containment system (currently extraction wells EX-1, EXH-3, EX-4 and EX-10) captures this area of contamination. Figure 2 in Appendix A shows the zone of contamination at the northern border of the NHBB facility. Additional evaluation of this data and area is needed. Since the contamination extends outside of the "TI waiver area" and may not be captured by the containment system, the protectiveness of the remedy is called into question.

Using growth projections for the town of Peterborough, the future needs for town water supply were recently provided through verbal communication from the town to NHDES and EPA on June 3, 2008. The South Well is not currently being pumped. However, the water supply provided by the South Well is needed within a five to ten year time frame. The town has a successful and aggressive leak detection and correction program for their current water source (which has reduced demand) and is considering implementing a formal water conservation program. The re-establishment of aquifer use would insure adequate water supply for the town and also result in water resources for water supplies that are in different locations of the town; providing some higher degree of safety for the town's water supply infrastructure.

#### **7.4 Technical Assessment**

Based on the data reviewed, observations from the Site visit, and the interviews conducted, the remedy is not functioning as intended by the ROD and subsequent ESDs. The pertinent issues are presented below in Section 8.0.

#### **8.0 ISSUES**

The issues that affect the protectiveness of the remedy include:

- The pumping of the South Well at approximately 150 gpm revealed that the containment system does not capture all portions of the contaminant plume while operating the South Well. Future usage of the South Well at 400 to 500 gpm is three times greater than the pumping test. Currently, there are no engineering remedies in place that remove contamination source mass within the "TI waiver area" or additional extraction wells at the eastern border of the "TI waiver area" that can be brought on line to increase the certainty of containment to allow South Well reactivation at 400 to 500 gpm. Current operations (without the South Well operating) appear to contain the plume as evidenced by reductions of concentrations to the east of the "TI waiver area". With the South Well currently not operating, the current protectiveness is not affected.
- Contamination has been detected at concentrations above drinking water standards outside of the "TI waiver area" at the northern border of the NHBB facility. It is not known if the current containment system captures this area of contamination.

- Soil vapor concentrations have been detected below the NHBB facility that exceeds screening levels. In addition, drinking water standards used as clean-up levels remaining in effect for outside the "TI waiver area" are not designed to be protective of the vapor intrusion pathway. Vapor intrusion may affect the SDE facility and the residence on Sharon Road. There is insufficient data to evaluate the protectiveness of the remedy based on the vapor intrusion pathway.
- The aquifer protection zoning overlay district (Aquifer Protection District D) established by the town of Peterborough for the Site in the Code, Chapter 245 Zoning to disallow groundwater use throughout the Site was not maintained when the Code was revised as of March 2005. The oversight was not discovered in time to have the zoning overlay reinstated in 2008. The matter will be revisited by the town of Peterborough in 2009. Until that time, the institutional control set in place by the ROD is no longer functioning.

The issues identified during this review call into question the current and future protectiveness of the remedy.

**Table 8-1  
Issues**

<b>Issues</b>	<b>Affects Current Protectiveness (Y/N)</b>	<b>Affects Future Protectiveness (Y/N)</b>
The pumping of the South Well revealed that the containment system does not capture all portions of the contaminant plume while operating the South Well at approximately 150 gpm; and contamination has been detected at concentrations above drinking water standards outside of the "TI waiver area" at the northern border of the NHBB facility (VP-17).	Y	Y
Soil vapor concentrations have been detected below the NHBB facility that exceeds NHDES commercial screening levels. In addition, drinking water standards used as clean-up levels remaining in effect for outside the "TI waiver area" are not designed to be protective of the vapor intrusion pathway.	Y	Y
The aquifer protection zoning overlay district (Aquifer Protection District D) established by the town of Peterborough for the Site in the Code, Chapter 245 Zoning to disallow groundwater use throughout the Site was not maintained when the Code was revised as of March 2005.	Y	Y

## 9.0 RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Alternative remedial technologies focused on DNAPL source reduction should be evaluated and implemented within the "TI waiver area" to improve the plume containment system to affect capture, address long term O&M issues, increase the certainty and cost effectiveness of the remedy, and allow the concurrent use of the aquifer for water supply purposes. A FFS and ROD amendment are planned for the Site. This recommendation/follow-up action addresses the issue of the containment system not capturing all portions of the contaminant plume while operating the South Well as well as the contamination detected outside the "TI waiver area" at the northern border of the NHBB facility.

A vapor intrusion assessment should be implemented to determine if there is a viable inhalation exposure pathway to workers in the NHBB facility as well as any off-site businesses and/or residences that may be affected by the groundwater plume. More specifically, the SDE facility and the residence on Sharon Road.

The aquifer protection zoning overlay district (Aquifer Protection District D) should be reinstated by the town of Peterborough to the Peterborough Code, Chapter 245 Zoning in 2009.

**Table 9-1  
Recommendations/Follow-up Actions**

Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-up Actions: Affects Protectiveness (Y/N)	
				Current	Future
Evaluate alternative remedial technologies and implement approved engineering technology in the "TI waiver area" and at the northern property boundary outside the "TI waiver area"	NHBB	EPA/NHDES	Final FFS - 3/30/2009 ROD Amendment - 11/30/2009	Y	Y
Implement vapor intrusion assessment in "TI waiver area" and outside "TI waiver area" (dissolved plume).	NHBB	EPA/NHDES	10/30/2008	Y	Y
Reinstate the aquifer protection zoning overlay district (Chapter 245 Zoning).	town of Peterborough	EPA/NHDES	7/30/2009	Y	Y

## **10.0 PROTECTIVENESS STATEMENTS**

The remedy is not protective because of the following issues:

- The containment system cannot capture all portions of the contaminant plume at the NHBB property boundary while operating the South Well;
- Contamination outside of the "TI waiver area" at the northern border of the NHBB facility is above drinking water standards;
- There is insufficient data to evaluate the protectiveness of the remedy based on the vapor intrusion pathway; and
- The aquifer protection zoning overlay is not currently maintained in the Peterborough Code revised March 2005.

The following actions need to be taken:

- Alternative remedial technologies focused on DNAPL source reduction need to be evaluated and implemented to increase the certainty and cost effectiveness of the remedy, and allow the concurrent use of the aquifer for water supply purposes;
- A vapor intrusion assessment should be implemented to determine if there is a viable inhalation exposure pathway to workers in the NHBB facility as well as any off-site businesses and/or residences that may be affected by the groundwater plume; and
- The aquifer protection zoning overlay district (Aquifer Protection District D) also needs to be reinstated by the town of Peterborough to the Peterborough Code, Chapter 245 Zoning.

## **11.0 NEXT REVIEW**

The fourth five-year review for the Site will be conducted in 2013 either on or prior to five years from the date of signature of this report. Statutory five-year reviews are required for this Site since hazardous contamination remains above levels that allow for unlimited use and unrestricted exposure.

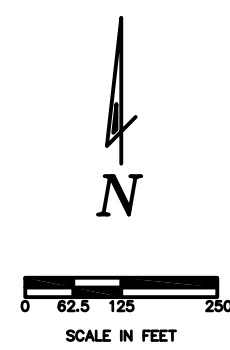


## **APPENDIX A**

### **SITE FIGURES**

(Figures provided by New Hampshire Ball Bearings contractor,  
Hull & Associates, Inc., for the purpose of the five-year review)





- LEGEND**
- TECHNICAL IMPRACTICABILITY WAIVER AREA
- VOC CONCENTRATIONS (ppb):**
- >100,000 ug/L
  - 10,000 – 100,000 ug/L
  - 1,000 – 10,000 ug/L
  - 100 – 1,000 ug/L
  - 10 – 100 ug/L
  - 1 – 10 ug/L

NOTE:  
THE TI WAIVER IS INFERRED FROM THE VERBIAGE  
OF THE 1997 EXPLANATION OF SIGNIFICANT  
DIFFERENCES AND AS DEPICTED IN THE SECOND  
5-YEAR REVIEW.

NOTE:  
UPLAND FARMS SPRING WATER COMPANY IS  
LOCATED APPROXIMATELY 1,300 FEET DUE  
SOUTH OF THE SOUTH WELL.

**DRAFT**

SOURCE: THIS DRAWING WAS RE-DRAFTED FROM T.F. MORAN, INC. "BOUNDARY PLAN OF  
LAND FOR NEW HAMPSHIRE BALL BEARINGS, INC.", DATED JANUARY 19, 1990.

**Hull**  
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4770 DUKE DRIVE  
SUITE 300  
MASON, OHIO 45040  
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PHONE: (513) 459-9677  
FAX: (513) 459-9869  
www.hullinc.com

SOUTH MUNICIPAL WATER SUPPLY WELL SUPERFUND SITE 5 YEAR REVIEW	
FIGURE 2 APPROXIMATED PLUME MAP BASED ON OCTOBER 2007 AND APRIL 2008 GROUNDWATER DATA	
PETERBOROUGH, NEW HAMPSHIRE	
PROJECT NO.: NHB033	SUBMITTAL DATE: JULY 2008
CAD DWG FILE: NHB033.200.0085	PLOT DATE: 07/24/08

**APPENDIX B**  
**DATA SUMMARY TABLES**

**NEW HAMPSHIRE BALL BEARINGS, INC.  
SOUTH MUNICIPAL WATER SUPPLY WELL SUPERFUND SITE**

**TABLE 12**

**SUMMARY OF ANNUAL AND CUMULATIVE GALLONS OF GROUNDWATER TREATED OVER THIRTEEN YEARS OF OPERATION**

Operational Year	Groundwater Treated (gallons) <sup>1</sup>								Annual Totals
	EX-1	EXH-3	EX-4	EX-5A	EX-6	EX-7	EX-9	EX-10	
Year 1	45,328,270	36,160,754	90,147,232	24,527,124	4,625,280	50,421,334	13,751,272	-- <sup>5</sup>	264,961,266
Year 2	46,641,744	38,868,120	78,772,723	30,873,744	3,071,606	54,543,614	11,919,557	-- <sup>5</sup>	264,691,108
Year 3	49,046,469	38,872,115	78,322,179	27,512,532	2,955,291	59,406,360	9,075,745	-- <sup>5</sup>	265,190,691
Year 4	14,754,643	11,767,133	89,728,119	14,646,580	18,077,486	37,848,719	2,758,874	-- <sup>5</sup>	189,581,554
Year 5	-- <sup>2</sup>	-- <sup>2</sup>	91,221,349	13,907,376	-- <sup>2</sup>	36,003,600	-- <sup>2</sup>	-- <sup>5</sup>	141,132,325
Year 6	-- <sup>2</sup>	-- <sup>2</sup>	71,507,223	18,282,996	-- <sup>2</sup>	-- <sup>3</sup>	-- <sup>2</sup>	-- <sup>5</sup>	89,790,219
Year 7	-- <sup>2</sup>	-- <sup>2</sup>	56,678,076	10,825,783	-- <sup>2</sup>	-- <sup>3</sup>	-- <sup>2</sup>	-- <sup>5</sup>	67,503,859
Year 8	-- <sup>2</sup>	-- <sup>2</sup>	43,847,654	-- <sup>4</sup>	-- <sup>2</sup>	-- <sup>3</sup>	-- <sup>2</sup>	-- <sup>5</sup>	43,847,654
Year 9	-- <sup>2</sup>	-- <sup>2</sup>	34,815,744	-- <sup>4</sup>	-- <sup>2</sup>	-- <sup>3</sup>	-- <sup>2</sup>	5,298,048	40,113,792
Year 10	-- <sup>2</sup>	-- <sup>2</sup>	33,173,078	15,573,197	-- <sup>2</sup>	-- <sup>3</sup>	-- <sup>2</sup>	32,769,828	81,516,103
Year 11	-- <sup>2</sup>	-- <sup>2</sup>	31,788,288	21,289,954	-- <sup>2</sup>	-- <sup>3</sup>	-- <sup>2</sup>	12,961,822	66,040,063
Year 12	-- <sup>2</sup>	-- <sup>2</sup>	27,666,533	14,939,654	-- <sup>2</sup>	-- <sup>3</sup>	-- <sup>2</sup>	20,432,174	63,038,362
Year 13	6,558,000	6,558,000	22,848,912	19,239,750	-- <sup>2</sup>	-- <sup>3</sup>	-- <sup>2</sup>	15,350,040	70,554,702
<b>Total Treated Over Thirteen Years:</b>									<b>1,647,961,698</b>

**Notes:**

1. Based on the yearly average pumping rate and percent operational rate observed during each operational year.
2. Extraction wells EX-1, EXH-3, EX-6, and EX-9 were deactivated (with EPA approval) on June 26, 1997 coincident with implementation of the containment phase of RD/RA.
3. EX-7 was deactivated with EPA approval on November 17, 1998.
4. EX-5A was shutdown between October 9, 2000 and August 9, 2003 as part of an investigation into persistent VOC concentrations near the end of the plume.
5. EX-10 was installed during Year 8. Pumping was initiated at EX-10 during Year 9.
6. EX-1 and EXH-3 pumping rates are estimated at 25 gpm; wells were reactivated June 26, 2006.

**NEW HAMPSHIRE BALL BEARINGS, INC.  
SOUTH MUNICIPAL WATER SUPPLY WELL SUPERFUND SITE**

**TABLE 14**

**SUMMARY OF VOCs REMOVED THROUGH THIRTEEN YEARS OF OPERATION**

Operational Year	PCE		1,1,1-TCA		TCE		Total VOCs	
	Pounds	Gallons	Pounds	Gallons	Pounds	Gallons	Pounds	Gallons
<b>Year 1</b>	3,017	222.7	902	80.0	367	30.1	4,286	332.8
<b>Year 2</b>	1,178	86.9	273	24.2	99	8.1	1,550	119.3
<b>Year 3</b>	993	73.3	185	16.4	68	5.5	1,246	95.2
<b>Year 4</b>	278	20.5	51	4.5	3	0.2	332	25.3
<b>Year 5</b>	31	2.3	84	7.5	23	1.9	139	11.7
<b>Year 6</b>	46	3.4	34	3.0	20	1.7	101	8.1
<b>Year 7</b>	100	7.4	42	3.7	34	2.8	175	13.8
<b>Year 8</b>	70	5.1	44	3.9	20	1.6	133	10.6
<b>Year 9</b>	37	2.7	21	1.9	8	0.7	67	5.3
<b>Year 10</b>	70	5.1	55	4.9	21	1.7	146	11.8
<b>Year 11</b>	102	7.5	25	1.8	17	1.2	144	10.5
<b>Year 12</b>	166	12.3	36	3.2	21	1.8	224	17.2
<b>Year 13</b>	145	10.7	75	6.7	69	5.6	289	23.0
<b>Totals:</b>	<b>6,233</b>	<b>460</b>	<b>1,829</b>	<b>162</b>	<b>771</b>	<b>63</b>	<b>8,833</b>	<b>685</b>

**APPENDIX C**  
**INTERVIEW LIST**

**INTERVIEW LIST INDIVIDUALS INTERVIEWED FOR  
THE SOUTH MUNICIPAL WATER SUPPLY WELL SUPERFUND SITE  
FIVE-YEAR REVIEW**

<b>Name/Position</b>	<b>Organization/Location</b>	<b>Date</b>
Ron Bowman	SDE, Inc. - Staff Development for Educators Peterborough, NH	4/15/08
Patricia Carrier Facilities Manager	New Hampshire Ball Bearings, Inc. Peterborough, NH	5/1/08
Tom Andrews Sanitary Engineer III	Waste Management New Hampshire Department of Environmental Services Concord, NH	5/1/08
Rodney Bartlett Public Works Director	town of Peterborough Peterborough, NH	5/1/08
Lance Turley Principal	Hull & Associates, Inc. Mason, Ohio (consultant to NHBB)	5/8/08
Tracy Edwards Project Manager	Hull & Associates, Inc. Mason, Ohio (consultant to NHBB)	5/8/08
Pam Brenner Town Administrator	Town of Peterborough Peterborough, NH	5/21/08



**APPENDIX D**  
**COMMUNITY NOTIFICATION**

## **EPA Starts Five-Year Review of South Municipal Water Supply Well Superfund Site**

The U.S. Environmental Protection Agency (EPA) has begun its third Five-Year Review of the South Municipal Water Supply Well Superfund Site, Peterborough, NH. Five-Year Reviews are required by law and occur every five years. The reviews determine if the cleanup is protective of human health and the environment. This Five-Year Review will be completed by July 2008 and the results will be publicly available.

The Superfund Site cleanup plan implemented by New Hampshire Ball Bearing Company (NHBB) included construction of a groundwater pump and treatment system, vacuum extraction for areas of soils contaminated with VOCs, and excavation with off-site disposal of PCB contaminated sediments from the wetland. In 1997, a revised decision provided NHBB with a waiver for achievement of groundwater clean up standards on their property. Additional measures included institutional controls during groundwater treatment.

Contaminants at the site included VOCs; on-site in the soils and adjacent wetlands surface water. Wetlands sediments were also contaminated with VOCs and polychlorinated biphenyls (PCBs). The ground water is contaminated with VOCs. Ground water treatment is ongoing.

More information about the cleanup can be found on-line at [www.epa.gov/ne/superfund/sites/southmuni](http://www.epa.gov/ne/superfund/sites/southmuni) or at the Peterborough Town Library, Main and Concord Streets, Peterborough, NH 03458.



United States  
Environmental Protection  
Agency New England

For more information, contact:  
Richard Goehlert, Toll Free  
1-888-372-7341, ext. 81335  
[goehlert.dick@epa.gov](mailto:goehlert.dick@epa.gov)  
Thomas Andrews (NHDES)  
[Thomas.Andrews@des.nh.gov](mailto:Thomas.Andrews@des.nh.gov)

**APPENDIX E**  
**DOCUMENT REVIEW LIST/REFERENCES**

## DOCUMENTS REVIEWED/REFERENCES CITED

- EMTEK, 1989. *Feasibility Study*. EMTEK, Inc. July 1989.
- EPA, 1989. *Record of Decision*. Environmental Protection Agency. September 27, 1989.
- EPA, 1997. *Explanation of Significant Differences*. Environmental Protection Agency. February 3, 1997.
- EPA, 1998. *Five Year Review Report*. Environmental Protection Agency. June 2, 1998.
- EPA, 2001. *Comprehensive Five-Year Review Guidance*. Environmental Protection Agency. June 2001.
- EPA, 2002. *OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils*. Environmental Protection Agency. November 2002.
- EPA, 2003. *Second Five Year Review Report*. Environmental Protection Agency. June 2, 2003.
- Hillsborough County Registry of Deeds: Book 5199, Page 1414. July 16, 1990.  
<<http://www.nhdeeds.com/hils/web/HiHome.html>> (May 13, 2008).
- Hillsborough County Registry of Deeds: Book 6171, Page 1713. October 21, 1999.  
<<http://www.nhdeeds.com/hils/web/HiHome.html>> (May 13, 2008).
- Hull, 2005a. *Annual Groundwater Monitoring Report – Year 10*. Hull &.Associates, Inc. October 2005.
- Hull, 2005b. *Annual Groundwater Monitoring Report – Year 11*. Hull &.Associates, Inc. October 2005.
- Hull, 2006. *Annual Groundwater Monitoring Report – Year 12*. Hull &.Associates, Inc. July 2006.
- Hull, 2007a. *Annual Groundwater Monitoring Report – Year 13*. Hull &.Associates, Inc. July 2007.
- Hull, 2007b. *Source Area Delineation Summary Report*. Hull &.Associates, Inc. November 2007.
- Hull, 2008. *Work Plan for Groundwater Focused Feasibility Study*. Hull &.Associates, Inc. March 8, 2008.
- NHDES, 2006. *Vapor Intrusion Guidance*. New Hampshire Department of Environmental Services. July 2006.

**APPENDIX F**  
**SITE INSPECTION CHECKLIST**

## Site Inspection Checklist

I. SITE INFORMATION	
<b>Site name:</b> South Municipal Water Well Supply	<b>Date of inspection:</b> May 1, 2008
<b>Location and Region:</b> Peterborough, NH – Region 1	<b>EPA ID:</b> NHD980671069
<b>Agency, office, or company leading the five-year review:</b> EPA	<b>Weather/temperature:</b> Sunny, ~70
<b>Remedy Includes:</b> (Check all that apply) <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <div style="width: 45%;"> <input type="checkbox"/> Landfill cover/containment  <input type="checkbox"/> Access controls  <input checked="" type="checkbox"/> Institutional controls  <input checked="" type="checkbox"/> Groundwater pump and treatment  <input type="checkbox"/> Surface water collection and treatment  <input type="checkbox"/> Other _____             </div> <div style="width: 45%;"> <input type="checkbox"/> Monitored natural attenuation  <input checked="" type="checkbox"/> Groundwater containment  <input type="checkbox"/> Vertical barrier walls             </div> </div>	
<b>Attachments:</b> <input type="checkbox"/> Inspection team roster attached <input type="checkbox"/> Site map attached	
II. INTERVIEWS (Check all that apply)	
<div style="display: flex; justify-content: space-between;"> <div>1. <b>O&amp;M site manager</b></div> <div><u>Patricia Carrier</u></div> <div><u>Facilities/Environmental Manager</u></div> <div><u>5/1/2008</u></div> </div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <div>Name</div> <div>Title</div> <div>Date</div> </div> <p>Interviewed <input checked="" type="checkbox"/> at site   <input type="checkbox"/> at office   <input type="checkbox"/> by phone   Phone no. _____</p> <p>Problems, suggestions; <input type="checkbox"/> Report attached <u>NHBB is investigating alternative technologies to reduce the source contamination, as well as looking into further vapor intrusion investigations of the facility.</u></p>	
<div style="display: flex; justify-content: space-between;"> <div>2. <b>O&amp;M staff</b></div> <div>_____</div> <div>_____</div> <div>_____</div> </div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <div>Name</div> <div>Title</div> <div>Date</div> </div> <p>Interviewed <input type="checkbox"/> at site   <input type="checkbox"/> at office   <input type="checkbox"/> by phone   Phone no. _____</p> <p>Problems, suggestions; <input type="checkbox"/> Report attached _____</p>	

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency NHDES

Contact Tom Andrews Waste Management Division 5/1/2008 \_\_\_\_\_

Name

Title

Date

Phone no.

Problems; suggestions; ☐ Report attached Discussed the need for other remedial technologies outside of the containment system to reduce the source contamination and to work towards reuse of the South Well.

Agency \_\_\_\_\_

Contact \_\_\_\_\_

Name

Title

Date

Phone no.

Problems; suggestions; ☐ Report attached \_\_\_\_\_

Agency \_\_\_\_\_

Contact \_\_\_\_\_

Name

Title

Date

Phone no.

Problems; suggestions; ☐ Report attached \_\_\_\_\_

Agency \_\_\_\_\_

Contact \_\_\_\_\_

Name

Title

Date

Phone no.

Problems; suggestions; ☐ Report attached \_\_\_\_\_

4. **Other interviews** (optional) ☐ Report attached.


III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)				
1.	<b>O&amp;M Documents</b> <input checked="" type="checkbox"/> O&M manual <input type="checkbox"/> As-built drawings <input type="checkbox"/> Maintenance logs Remarks _____	<input type="checkbox"/> Readily available <input type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input type="checkbox"/> Up to date	<input type="checkbox"/> N/A <input checked="" type="checkbox"/> N/A <input type="checkbox"/> N/A
2.	<b>Site-Specific Health and Safety Plan</b> <input type="checkbox"/> Contingency plan/emergency response plan Remarks _____	<input type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date	<input type="checkbox"/> N/A <input type="checkbox"/> N/A
3.	<b>O&amp;M and OSHA Training Records</b> Remarks _____	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input type="checkbox"/> N/A
4.	<b>Permits and Service Agreements</b> <input type="checkbox"/> Air discharge permit <input type="checkbox"/> Effluent discharge <input type="checkbox"/> Waste disposal, POTW <input type="checkbox"/> Other permits _____ Remarks _____	<input type="checkbox"/> Readily available <input type="checkbox"/> Readily available <input type="checkbox"/> Readily available <input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input type="checkbox"/> Up to date <input type="checkbox"/> Up to date	<input type="checkbox"/> N/A <input type="checkbox"/> N/A <input type="checkbox"/> N/A <input type="checkbox"/> N/A
5.	<b>Gas Generation Records</b> Remarks _____	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
6.	<b>Settlement Monument Records</b> Remarks _____	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
7.	<b>Groundwater Monitoring Records</b> Remarks _____	<input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date	<input type="checkbox"/> N/A
8.	<b>Leachate Extraction Records</b> Remarks _____	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A
9.	<b>Discharge Compliance Records</b> <input checked="" type="checkbox"/> Air <input checked="" type="checkbox"/> Water (effluent) Remarks _____	<input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date <input checked="" type="checkbox"/> Up to date	<input type="checkbox"/> N/A <input type="checkbox"/> N/A
10.	<b>Daily Access/Security Logs</b> Remarks _____	<input type="checkbox"/> Readily available	<input type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A



IV. O&M COSTS
---------------

1. **O&M Organization**

<input type="checkbox"/> State in-house	<input type="checkbox"/> Contractor for State
<input checked="" type="checkbox"/> PRP in-house	<input checked="" type="checkbox"/> Contractor for PRP
<input type="checkbox"/> Federal Facility in-house	<input type="checkbox"/> Contractor for Federal Facility
<input type="checkbox"/> Other _____	

\_\_\_\_\_

2. **O&M Cost Records**
- ☐ Readily available      ☐ Up to date
- ☐ Funding mechanism/agreement in place
- Original O&M cost estimate \_\_\_\_\_ ☐ Breakdown attached
- Total annual cost by year for review period if available
- |            |          |            |   |
|------------|----------|------------|---|
| From _____ | To _____ | _____      | <input type="checkbox"/> Breakdown attached |
| Date       | Date     | Total cost |   |
| From _____ | To _____ | _____      | <input type="checkbox"/> Breakdown attached |
| Date       | Date     | Total cost |   |
| From _____ | To _____ | _____      | <input type="checkbox"/> Breakdown attached |
| Date       | Date     | Total cost |   |
| From _____ | To _____ | _____      | <input type="checkbox"/> Breakdown attached |
| Date       | Date     | Total cost |   |
| From _____ | To _____ | _____      | <input type="checkbox"/> Breakdown attached |
| Date       | Date     | Total cost |   |

3. **Unanticipated or Unusually High O&M Costs During Review Period**  
 Describe costs and reasons: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**V. ACCESS AND INSTITUTIONAL CONTROLS** ☒ Applicable ☐ N/A

<b>A. Fencing</b>
-------------------

1.	<b>Fencing damaged</b>	<input type="checkbox"/> Location shown on site map	<input type="checkbox"/> Gates secured	<input checked="" type="checkbox"/> N/A
Remarks: <u>Property is fenced due to security issues pertaining to the business</u>				

- |  |
|--|
| <p><b>B. Other Access Restrictions</b></p> |
|--|

1.	<b>Signs and other security measures</b>	<input type="checkbox"/> Location shown on site map	<input checked="" type="checkbox"/> N/A
Remarks: _____			
_____			

-

<b>C. Institutional Controls (ICs)</b>				
1.	<b>Implementation and enforcement</b> <div style="display: flex; justify-content: space-between;"> <span>Site conditions imply ICs not properly implemented</span> <span><input type="checkbox"/> Yes   <input checked="" type="checkbox"/> No   <input type="checkbox"/> N/A</span> </div> <div style="display: flex; justify-content: space-between;"> <span>Site conditions imply ICs not being fully enforced</span> <span><input type="checkbox"/> Yes   <input checked="" type="checkbox"/> No   <input type="checkbox"/> N/A</span> </div> Type of monitoring ( <i>e.g.</i> , self-reporting, drive by) _____ Frequency _____ Responsible party/agency _____ Contact _____ <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <span>Name</span> <span>Title</span> <span>Date</span> <span>Phone no.</span> </div> <div style="display: flex; justify-content: space-between;"> <span>Reporting is up-to-date</span> <span><input type="checkbox"/> Yes   <input type="checkbox"/> No   <input checked="" type="checkbox"/> N/A</span> </div> <div style="display: flex; justify-content: space-between;"> <span>Reports are verified by the lead agency</span> <span><input type="checkbox"/> Yes   <input type="checkbox"/> No   <input checked="" type="checkbox"/> N/A</span> </div> <div style="display: flex; justify-content: space-between;"> <span>Specific requirements in deed or decision documents have been met</span> <span><input checked="" type="checkbox"/> Yes   <input type="checkbox"/> No   <input type="checkbox"/> N/A</span> </div> <div style="display: flex; justify-content: space-between;"> <span>Violations have been reported</span> <span><input type="checkbox"/> Yes   <input type="checkbox"/> No   <input checked="" type="checkbox"/> N/A</span> </div> <div style="display: flex; justify-content: space-between;"> <span>Other problems or suggestions:</span> <span><input type="checkbox"/> Report attached</span> </div> <u>Zoning ordinance for the aquifer protection zoning overlay district (Aquifer Protection District D)</u> <u>was not maintained in the Peterborough Code, Chapter 245 Zoning.</u>  			
2.	<b>Adequacy</b> <input checked="" type="checkbox"/> ICs are adequate <input type="checkbox"/> ICs are inadequate <input type="checkbox"/> N/A Remarks _____  			
<b>D. General</b>				
1.	<b>Vandalism/trespassing</b> <input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> No vandalism evident Remarks _____ 			
2.	<b>Land use changes on site</b> <input checked="" type="checkbox"/> N/A Remarks _____ 			
3.	<b>Land use changes off site</b> <input checked="" type="checkbox"/> N/A Remarks _____ 			
<b>VI. GENERAL SITE CONDITIONS</b>				
<b>A. Roads</b> <input checked="" type="checkbox"/> Applicable <input type="checkbox"/> N/A				
1.	<b>Roads damaged</b> <input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> Roads adequate <input type="checkbox"/> N/A Remarks _____ 			

<b>B. Other Site Conditions</b>			
Remarks _____ _____ _____ _____ _____			
<b>VII. LANDFILL COVERS</b> <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A			
<b>A. Landfill Surface</b>			
1.	<b>Settlement</b> (Low spots) Areal extent _____ Depth _____ Remarks _____ _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> Settlement not evident	
2.	<b>Cracks</b> Lengths _____ Widths _____ Depths _____ Remarks _____ _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> Cracking not evident	
3.	<b>Erosion</b> Areal extent _____ Depth _____ Remarks _____ _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> Erosion not evident	
4.	<b>Holes</b> Areal extent _____ Depth _____ Remarks _____ _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> Holes not evident	
5.	<b>Vegetative Cover</b> <input type="checkbox"/> Grass <input type="checkbox"/> Cover properly established <input type="checkbox"/> No signs of stress <input type="checkbox"/> Trees/Shrubs (indicate size and locations on a diagram) Remarks _____ _____		
6.	<b>Alternative Cover (armored rock, concrete, etc.)</b> <input checked="" type="checkbox"/> N/A Remarks _____ _____		
7.	<b>Bulges</b> Areal extent _____ Height _____ Remarks _____ _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> Bulges not evident	

8.	<b>Wet Areas/Water Damage</b> <input type="checkbox"/> Wet areas <input type="checkbox"/> Ponding <input type="checkbox"/> Seeps <input type="checkbox"/> Soft subgrade Remarks _____ _____	<input type="checkbox"/> Wet areas/water damage not evident <input type="checkbox"/> Location shown on site map      Areal extent _____ <input type="checkbox"/> Location shown on site map      Areal extent _____ <input type="checkbox"/> Location shown on site map      Areal extent _____ <input type="checkbox"/> Location shown on site map      Areal extent _____
9.	<b>Slope Instability</b> <input type="checkbox"/> Slides <input type="checkbox"/> Location shown on site map <input type="checkbox"/> No evidence of slope instability Areal extent _____ Remarks _____ _____	
<b>B. Benches</b> <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A (Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)		
1.	<b>Flows Bypass Bench</b> Remarks _____ _____	<input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> N/A or okay
2.	<b>Bench Breached</b> Remarks _____ _____	<input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> N/A or okay
3.	<b>Bench Overtopped</b> Remarks _____ _____	<input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> N/A or okay
<b>C. Letdown Channels</b> <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A (Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)		
1.	<b>Settlement</b> Areal extent _____      Depth _____ Remarks _____ _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> No evidence of settlement
2.	<b>Material Degradation</b> Material type _____      Areal extent _____ Remarks _____ _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> No evidence of degradation
3.	<b>Erosion</b> Areal extent _____      Depth _____ Remarks _____ _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> No evidence of erosion

4.	<b>Undercutting</b> Areal extent _____ Depth _____ Remarks _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> No evidence of undercutting	
5.	<b>Obstructions</b> Type _____ <input type="checkbox"/> No obstructions <input type="checkbox"/> Location shown on site map                      Areal extent _____ Size _____ Remarks _____		
6.	<b>Excessive Vegetative Growth</b> Type _____ <input type="checkbox"/> No evidence of excessive growth <input type="checkbox"/> Vegetation in channels does not obstruct flow <input type="checkbox"/> Location shown on site map                      Areal extent _____ Remarks _____		
<b>D. Cover Penetrations</b> <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A			
1.	<b>Gas Vents</b> <input type="checkbox"/> Active <input type="checkbox"/> Passive <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition <input type="checkbox"/> Evidence of leakage at penetration <input type="checkbox"/> Needs Maintenance <input checked="" type="checkbox"/> N/A Remarks _____		
2.	<b>Gas Monitoring Probes</b> <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition <input type="checkbox"/> Evidence of leakage at penetration <input type="checkbox"/> Needs Maintenance <input checked="" type="checkbox"/> N/A Remarks _____		
3.	<b>Monitoring Wells</b> (within surface area of landfill) <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition <input type="checkbox"/> Evidence of leakage at penetration <input type="checkbox"/> Needs Maintenance <input checked="" type="checkbox"/> N/A Remarks _____		
4.	<b>Leachate Extraction Wells</b> <input type="checkbox"/> Properly secured/locked <input type="checkbox"/> Functioning <input type="checkbox"/> Routinely sampled <input type="checkbox"/> Good condition <input type="checkbox"/> Evidence of leakage at penetration <input type="checkbox"/> Needs Maintenance <input checked="" type="checkbox"/> N/A Remarks _____		
5.	<b>Settlement Monuments</b> <input type="checkbox"/> Located <input type="checkbox"/> Routinely surveyed <input checked="" type="checkbox"/> N/A Remarks _____		

<b>E. Gas Collection and Treatment</b>			<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
1.	<b>Gas Treatment Facilities</b> <input type="checkbox"/> Flaring <input type="checkbox"/> Thermal destruction <input type="checkbox"/> Collection for reuse <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____			
2.	<b>Gas Collection Wells, Manifolds and Piping</b> <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____			
3.	<b>Gas Monitoring Facilities</b> ( <i>e.g.</i> , gas monitoring of adjacent homes or buildings) <input type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance <input checked="" type="checkbox"/> N/A Remarks _____ _____			
<b>F. Cover Drainage Layer</b>			<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
1.	<b>Outlet Pipes Inspected</b> <input type="checkbox"/> Functioning <input checked="" type="checkbox"/> N/A Remarks _____ _____			
2.	<b>Outlet Rock Inspected</b> <input type="checkbox"/> Functioning <input checked="" type="checkbox"/> N/A Remarks _____ _____			
<b>G. Detention/Sedimentation Ponds</b>			<input type="checkbox"/> Applicable	<input checked="" type="checkbox"/> N/A
1.	<b>Siltation</b> Areal extent _____ Depth _____ <input checked="" type="checkbox"/> N/A <input type="checkbox"/> Siltation not evident Remarks _____ _____			
2.	<b>Erosion</b> Areal extent _____ Depth _____ <input type="checkbox"/> Erosion not evident Remarks _____ _____			
3.	<b>Outlet Works</b> <input type="checkbox"/> Functioning <input checked="" type="checkbox"/> N/A Remarks _____ _____			
4.	<b>Dam</b> <input type="checkbox"/> Functioning <input checked="" type="checkbox"/> N/A Remarks _____ _____			

<b>H. Retaining Walls</b> <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A		
1.	<b>Deformations</b> Horizontal displacement _____ Rotational displacement _____ Remarks _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> Deformation not evident Vertical displacement _____
2.	<b>Degradation</b> Remarks _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> Degradation not evident
<b>I. Perimeter Ditches/Off-Site Discharge</b> <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A		
1.	<b>Siltation</b> Areal extent _____ Remarks _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> Siltation not evident Depth _____
2.	<b>Vegetative Growth</b> <input type="checkbox"/> Vegetation does not impede flow Areal extent _____ Remarks _____	<input type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> N/A Type _____
3.	<b>Erosion</b> Areal extent _____ Remarks _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> Erosion not evident Depth _____
4.	<b>Discharge Structure</b> <input type="checkbox"/> Functioning <input checked="" type="checkbox"/> N/A Remarks _____	
<b>VIII. VERTICAL BARRIER WALLS</b> <input type="checkbox"/> Applicable <input checked="" type="checkbox"/> N/A		
1.	<b>Settlement</b> Areal extent _____ Remarks _____	<input type="checkbox"/> Location shown on site map <input type="checkbox"/> Settlement not evident Depth _____
2.	<b>Performance Monitoring</b> Type of monitoring _____ <input type="checkbox"/> Performance not monitored Frequency _____ Head differential _____ Remarks _____	

<b>C. Treatment System</b>		<input checked="" type="checkbox"/> Applicable	<input type="checkbox"/> N/A
1.	<b>Treatment Train</b> (Check components that apply) <input type="checkbox"/> Metals removal <input type="checkbox"/> Oil/water separation <input type="checkbox"/> Bioremediation <input checked="" type="checkbox"/> Air stripping <input type="checkbox"/> Carbon adsorbers <input type="checkbox"/> Filters _____ <input type="checkbox"/> Additive (e.g., chelation agent, flocculent) _____ <input type="checkbox"/> Others _____ <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance <input checked="" type="checkbox"/> Sampling ports properly marked and functional <input type="checkbox"/> Sampling/maintenance log displayed and up to date <input checked="" type="checkbox"/> Equipment properly identified <input checked="" type="checkbox"/> Quantity of groundwater treated annually _____ <input type="checkbox"/> Quantity of surface water treated annually _____ Remarks _____ _____		
2.	<b>Electrical Enclosures and Panels</b> (properly rated and functional) <input type="checkbox"/> N/A <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____		
3.	<b>Tanks, Vaults, Storage Vessels</b> <input type="checkbox"/> N/A <input checked="" type="checkbox"/> Good condition <input checked="" type="checkbox"/> Proper secondary containment <input type="checkbox"/> Needs Maintenance Remarks _____ _____		
4.	<b>Discharge Structure and Appurtenances</b> <input type="checkbox"/> N/A <input checked="" type="checkbox"/> Good condition <input type="checkbox"/> Needs Maintenance Remarks _____ _____		
5.	<b>Treatment Building(s)</b> <input type="checkbox"/> N/A <input checked="" type="checkbox"/> Good condition (esp. roof and doorways) <input type="checkbox"/> Needs repair <input checked="" type="checkbox"/> Chemicals and equipment properly stored Remarks _____ _____		
6.	<b>Monitoring Wells</b> (pump and treatment remedy) <input checked="" type="checkbox"/> Properly secured/locked <input checked="" type="checkbox"/> Functioning <input checked="" type="checkbox"/> Routinely sampled <input checked="" type="checkbox"/> Good condition <input checked="" type="checkbox"/> All required wells located <input type="checkbox"/> Needs Maintenance <input type="checkbox"/> N/A Remarks _____ _____		
<b>D. Monitoring Data</b>			
1.	Monitoring Data <input checked="" type="checkbox"/> Is routinely submitted on time <input checked="" type="checkbox"/> Is of acceptable quality		
2.	Monitoring data suggests: <input checked="" type="checkbox"/> Groundwater plume is effectively contained <input checked="" type="checkbox"/> Contaminant concentrations are declining Remarks <u>New data was introduced on June 3, 2008 (after the site visit on May 1, 2008) that concludes that the groundwater plume is not being effectively contained at the northern border of the "TI waiver area".</u>		



<b>D. Monitored Natural Attenuation</b>			
1.	<b>Monitoring Wells</b> (natural attenuation remedy) <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <div> <input type="checkbox"/> Properly secured/locked  <input type="checkbox"/> All required wells located            Remarks _____         </div> <div> <input type="checkbox"/> Functioning  <input type="checkbox"/> Needs Maintenance         </div> <div> <input type="checkbox"/> Routinely sampled  <input checked="" type="checkbox"/> N/A         </div> <div> <input type="checkbox"/> Good condition         </div> </div>		
<b>X. OTHER REMEDIES</b>			
If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.			
<b>XI. OVERALL OBSERVATIONS</b>			
<b>A. Implementation of the Remedy</b>			
Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). <u>The remedy is to contain the contaminant plume within the TI waiver area and achieve drinking water MCLs outside the waiver area. At the time of this site inspection, the remedy appears to be effectively containing the contaminant plume within the TI waiver area with regular maintenance of the extraction wells to deal with biofouling issues.</u> _____ _____ _____ _____ _____ _____			
<b>B. Adequacy of O&amp;M</b>			
Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. <u>No issues.</u> _____ _____ _____ _____ _____ _____ _____ _____ _____			

<b>C. Early Indicators of Potential Remedy Problems</b>
<p>Describe issues and observations such as unexpected changes in the cost or scope of O&amp;M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future.</p> <p><u>Extraction wells EX-4 and EX-10 have biofouling issues that require maintenance at least twice a year to ensure proper pumping rates to achieve containment. NHBB implemented a new cleaning protocol in 2007 which included different chemicals for cleaning and redevelopment of the two wells. The biofouling issue continues to persist and decrease the efficiency of containment when the South Well is operating (as seen in the pumping test).</u></p> <hr/> <hr/> <hr/> <hr/>
<b>D. Opportunities for Optimization</b>
<p>Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.</p> <p><u>None.</u></p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>

## **APPENDIX G**

### **WORK PLAN FOR GROUNDWATER FOCUSED FEASIBILITY STUDY TABLES 1 AND 2**

**SOUTH MUNICIPAL WATER SUPPLY WELL SUPERFUND SITE  
PETERBOROUGH, NEW HAMPSHIRE**

**GROUNDWATER FOCUSED FEASIBILITY STUDY WORK PLAN  
TABLE 1**

**PRE-SCREENED REMEDIAL TECHNOLOGY METHODS FOR FOCUSED FEASIBILITY STUDY<sup>a</sup>**

CONCEPTUAL GROUNDWATER TREATMENT AREA	PRELIMINARY PATHWAYS OF CONCERN	PRELIMINARY ARRAY OF REMEDIAL ALTERNATIVES <sup>a</sup>
Source Area >100,000 ug/L	Groundwater Ingestion Groundwater to Indoor Air <sup>c</sup>	No action <i>In-situ</i> source reduction <sup>d</sup> and monitoring <i>In-situ</i> source reduction with containment <i>In-situ</i> source reduction with polishing technology <i>In-situ</i> source reduction with wellhead treatment at South Well Reactive barrier Hydraulic barrier with groundwater collection/treatment/discharge
Source Area > 10,000 ug/L	Groundwater Ingestion Groundwater to Indoor Air	No action <i>In-situ</i> source reduction and monitoring <i>In-situ</i> source reduction with containment <i>In-situ</i> source reduction with polishing technology <i>In-situ</i> source reduction with wellhead treatment at South Well
Source Area >1,000 ug/L	Groundwater Ingestion Groundwater to Indoor Air	No action <i>In-situ</i> source reduction and monitoring <i>In-situ</i> source reduction and containment <i>In-situ</i> source reduction and polishing technology
Area <1,000 but > 5 ug/L	Groundwater Ingestion	No action <sup>e</sup> Monitored Natural Attenuation Wellhead treatment at South Well <i>In-situ</i> reduction Reactive barrier
Dilute Plume East Rt. 202	Groundwater Ingestion	No action <sup>e</sup> Monitored Natural Attenuation Wellhead treatment at South Well

**Notes:**

- a Remedial technologies presented herein will be evaluated both singularly and in concert with compatible technologies
- b Institutional groundwater use restrictions have been imposed on the subject property and surrounding parcels via Town Ordinance
- c Implementation of source reduction technologies beneath the building will aid in mitigating the potential for vapor intrusion
- d Source reduction includes any technology that destroys mass, including ISCO, ISCR, and thermal
- e No action options with this note will be considered in concert with source area reduction and supported by groundwater modeling.

SOUTH MUNICIPAL WATER SUPPLY WELL SUPERFUND SITE  
PETERBOROUGH, NEW HAMPSHIRE

GROUNDWATER FOCUSED FEASIBILITY STUDY WORK PLAN  
TABLE 2

PRE-SCREENED REMEDIAL TECHNOLOGY PROCESS OPTIONS FOR FOCUSED FEASIBILITY STUDY

GROUNDWATER TARGET			REMEDIAL TECHNOLOGY	PROs	CONs	To Be Further Evaluated
Source Area >100,000 ug/L	Source Area > 10,000 ug/L	Source Area >1,000 ug/L	Thermal Destruction	Electrical Resistance Heating Conductance Thermal	Soil heterogeneity does not impact the effectiveness of the technology. Highly invasive. May hinder plant operations. High Cost.	YES
			Encapsulation/Stabilization	In-Situ Vittrification	Soil heterogeneity does not impact the effectiveness of the technology. Most widely used in the vadose zone, but can be applicable to saturated zone. Shallow water table would require additional energy to address groundwater or a dewatering mechanism would be required. Highly invasive. High cost.	NO
			In-Situ Destruction	In-Situ Chemical Oxidation Situ Chemical Reduction (Bioaugmentation)	In-Successful in source mass reduction given appropriate subsurface conditions. Moderate cost. Will also be considered as a polishing technology. Contaminant destruction relies upon contact with reagent. Therefore, geologic heterogeneity may limit successfulness of reagent applications. High likelihood of contaminant rebound.	YES
			Source Mass Reduction	Co-Solvent or Surfactant Flushing	Successful in source mass reduction given appropriate subsurface conditions. Heterogeneity and soil type may limit the delivery of surfactant/solvent into the DNAPL zone. Requires extraction of treated water. Given the potential for system fouling, may provide a mechanism of uncontrolled contaminant flux and redistribution. Moderate to High cost.	NO
			Containment/Reduction	Permeable Reactive Barrier	Will intercept and treat contaminated groundwater flowing through the source zone. Will require long term monitoring down gradient. Limited lifespan. Moderate to High cost.	NO
			Wellhead Treatment in concert with Source Reduction	Wellhead Treatment	Will allow for use of the South Well while mitigating ingestion exposures. Will require long term expenditures for monitoring and maintenance of the system. Public perception issues.	YES

SOUTH MUNICIPAL WATER SUPPLY WELL SUPERFUND SITE  
PETERBOROUGH, NEW HAMPSHIRE

GROUNDWATER FOCUSED FEASIBILITY STUDY WORK PLAN  
TABLE 2

PRE-SCREENED REMEDIAL TECHNOLOGY PROCESS OPTIONS FOR FOCUSED FEASIBILITY STUDY

GROUNDWATER TARGET	REMEDIAL TECHNOLOGY	REMEDIAL TECHNOLOGY	PROs	CONs	To Be Further Evaluated
Area <1,000 but >5 ug/L on NHBB Property	Passive Containment/Reduction	Permeable Reactive Barrier ISCO Barrier	Will passively intercept and treat groundwater near the downgradient property.	Will require long term monitoring. Will require regeneration	YES
	Active Containment/Reduction	Permeable Reactive Barrier with Extraction Extraction and Treatment Air Sparge/SVE In-well Air Stripping (ARTs)	Existing infrastructure is currently in place and could be upgraded or enhanced	The potential for biological fouling exists for any mechanical technology reliant on wells. Long term O&M expenditures.	YES
	In-Situ Destruction	In-Situ Chemical Oxidation In-Situ Chemical Reduction (Bioaugmentation)	Reduce contaminant concentrations in dissolved plume to allow for attenuation under natural groundwater flow.	Large treatment area. Moderate to high cost. Potential for rebound.	YES
	MNA	Modeling Monitored Natural Attenuation	Option considered in concert and supported by modeling efforts	High cost for groundwater modeling and long term expenditures for sampling.	YES
	No Action		Option considered in concert and supported by modeling efforts.	Public perception issues.	YES
Dilute plume located east of St. Route 202	No Action		Option considered in concert and supported by modeling efforts.	Public perception issues	YES
	MNA	Modeling Monitored Natural Attenuation	Option considered in concert and supported by modeling efforts	Long term expenditures for sampling	YES
	Wellhead Treatment	Wellhead Treatment	Will allow for use of the South Well while mitigating ingestion exposures.	Will require long term expenditures for monitoring and maintenance of the system. Public perception issues.	YES